Dissecting Malware 101

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https://github.com/conand/dissecting-malware-101

Malware???

- Malicious Software intentionally written to **violate** one or more **security policy**
- Different categories:
    - Virus: Infect hosts and files reproducing itself
    - Trojans: mislead users of its true intent
    - Ransomware: encrypt victim's files and ask for a ransom

How to analyze it?

Static Analysis

Dynamic Analysis

Static Analysis

- Understand the functionalities of a binary looking at its code.
- Disassemble instructions

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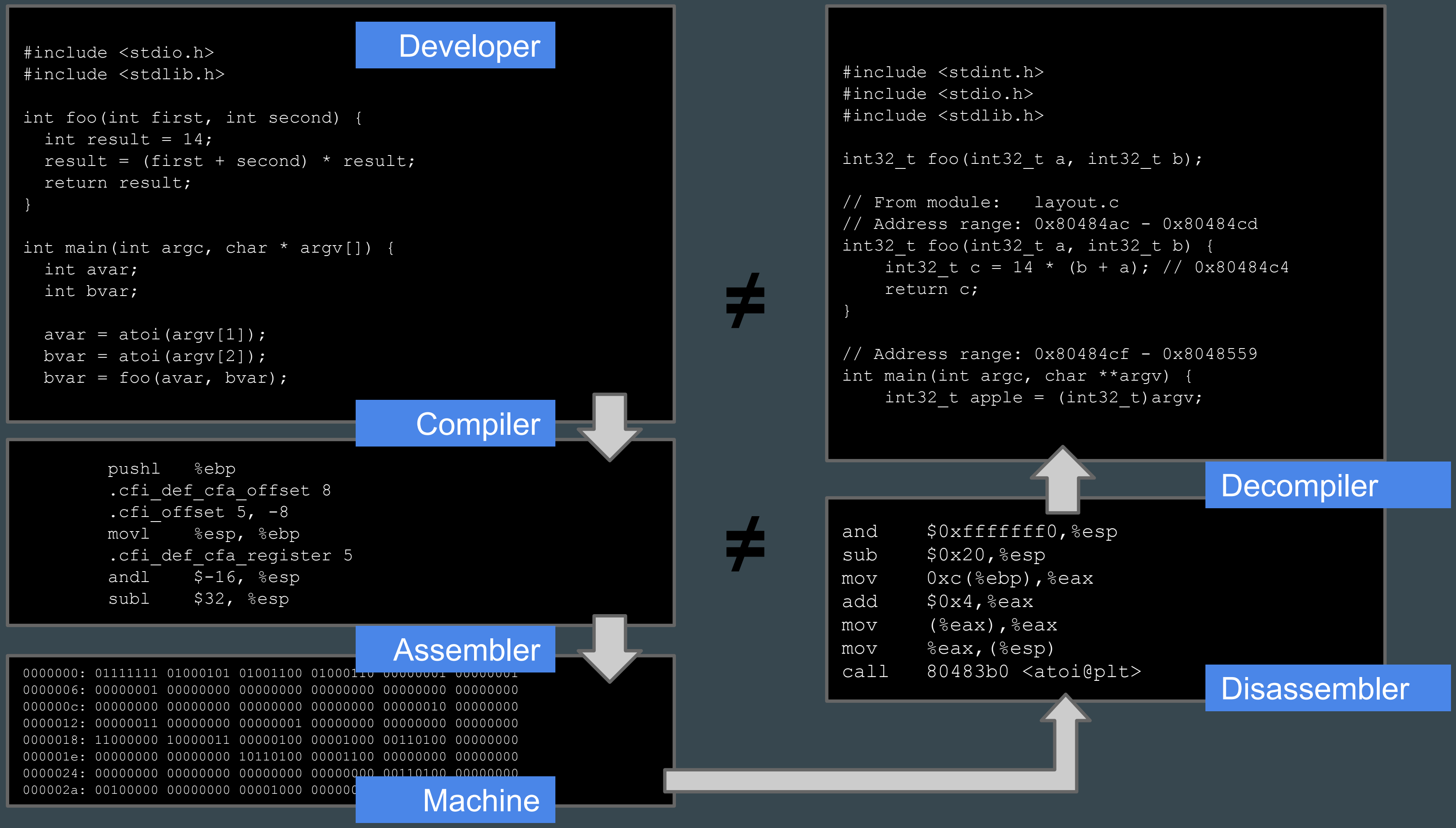

Developer

```
#include <stdio.h>
#include <stdlib.h>

int foo(int first, int second) {
  int result = 14;
  result = (first + second) * result;
  return result;
}

int main(int argc, char * argv[]) {
  int avar;
  int bvar;

  avar = atoi(argv[1]);
  bvar = atoi(argv[2]);
  bvar = foo(avar, bvar);
```

Compiler

```
        pushl   %ebp
        .cfi_def_cfa_offset 8
        .cfi_offset 5, -8
        movl    %esp, %ebp
        .cfi_def_cfa_register 5
        andl    $-16, %esp
        subl    $32, %esp
```

Assembler

```
0000000: 01111111 01000101 01001100 01000110 00000001 00000001
0000006: 00000001 00000000 00000000 00000000 00000000 00000000
000000c: 00000000 00000000 00000000 00000000 00000010 00000000
0000012: 00000011 00000000 00000001 00000000 00000000 00000000
0000018: 11000000 10000011 00000100 00001000 00110100 00000000
000001e: 00000000 00000000 10110100 00001100 00000000 00000000
0000024: 00000000 00000000 00000000 00000000 00110100 00000000
000002a: 00100000 00000000 00001000 000000
```

Machine

Disassembler

```
and     $0xfffffff0,%esp
sub     $0x20,%esp
mov     0xc(%ebp),%eax
add     $0x4,%eax
mov     (%eax),%eax
mov     %eax,(%esp)
call    80483b0 <atoi@plt>
```

Decompiler

```
#include <stdint.h>
#include <stdio.h>
#include <stdlib.h>

int32_t foo(int32_t a, int32_t b);

// From module:   layout.c
// Address range: 0x80484ac - 0x80484cd
int32_t foo(int32_t a, int32_t b) {
    int32_t c = 14 * (b + a); // 0x80484c4
    return c;
}

// Address range: 0x80484cf - 0x8048559
int main(int argc, char **argv) {
    int32_t apple = (int32_t)argv;
```

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Dynamic Analysis

- Execute the binary in a controlled environment and monitor its activity
- Look at interactions with the environment

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⚠ Evasive Malware can recognize analysis environment and hide its malicious behavior

Can we analyze one?

What if we create one…
…and then analyze it? :-)

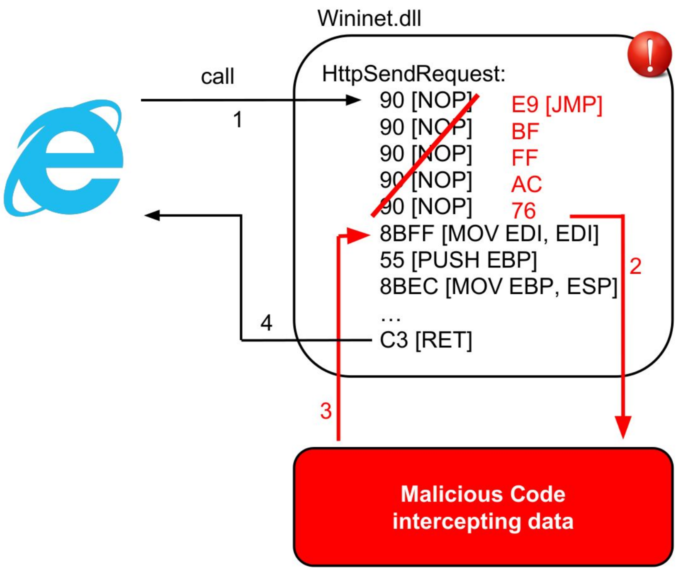
Who is ZeuS?

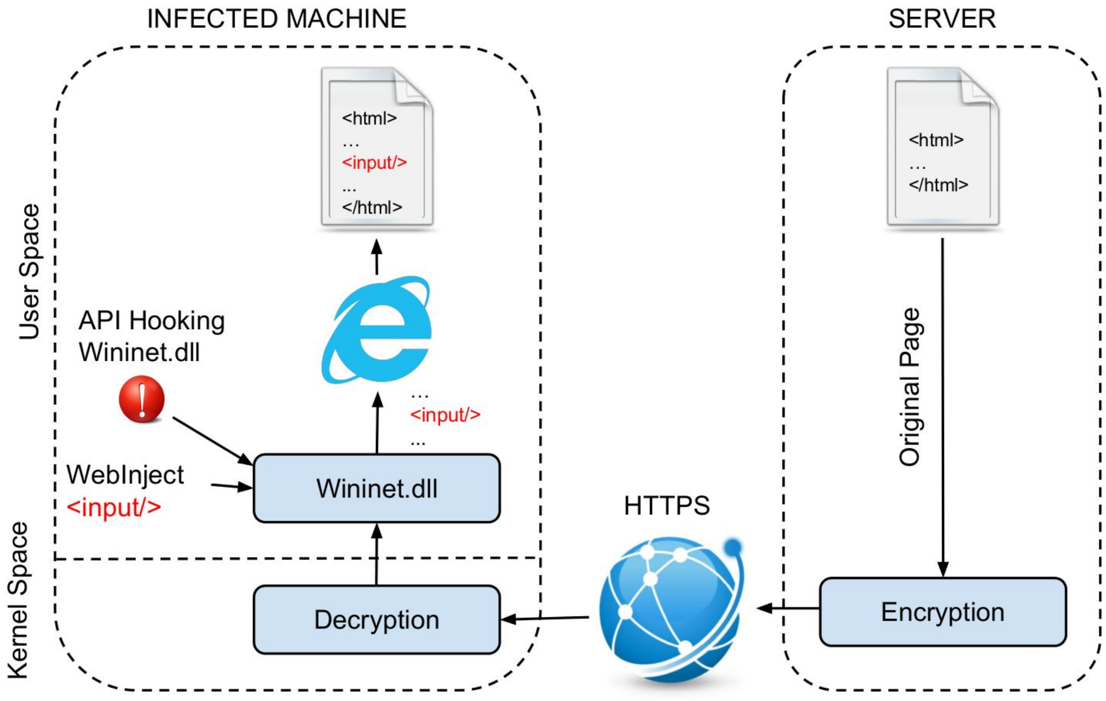
- One of the most famous “**Banking Trojans**”
- Perform “**Man in the Browser**” attacks to **steal** credentials and perform financial frauds
- Steal info submitted to web-forms
- Keylogger
- Record screenshots
- **Botnet** architecture

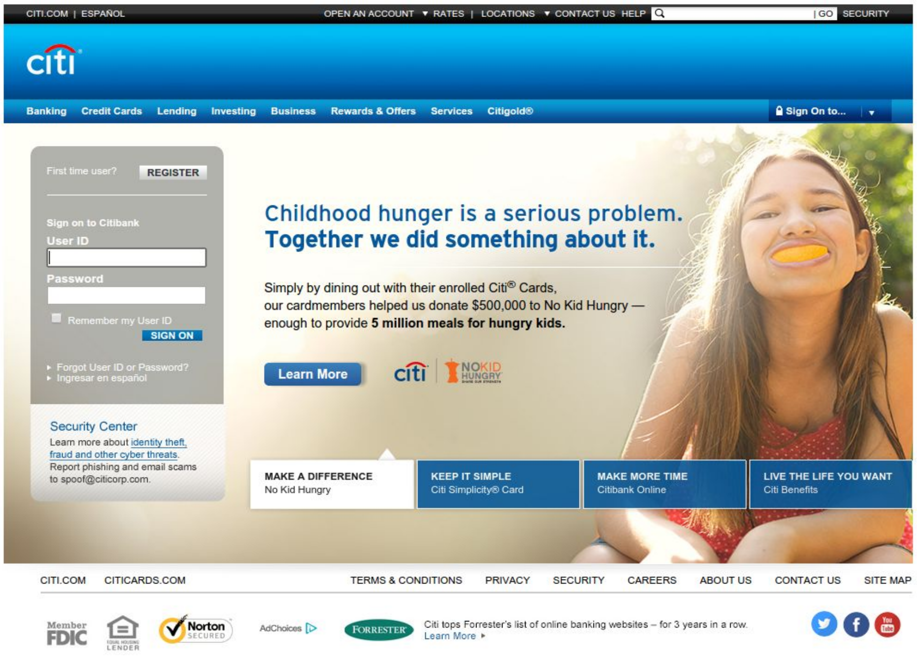
Leaked sources ~> https://github.com/Visgean/Zeus

How it works

- **API hooking:** intercept data flowing into the browser, even when the connection is encrypted (HTTPS)!
- **WebInject:** manipulate and modify web-pages locally
- **Goal:** modify web-pages to add further fields in forms and steal further information


Wininet.dll
call
1
HttpSendRequest:
~~90 [NOP]~~ E9 [JMP]
~~90 [NOP]~~ BF
~~90 [NOP]~~ FF
~~90 [NOP]~~ AC
~~90 [NOP]~~ 76
8BFF [MOV EDI, EDI]
55 [PUSH EBP]
8BEC [MOV EBP, ESP]
…
C3 [RET]
2
3
4
Malicious Code
intercepting data


INFECTED MACHINE
SERVER
User Space
Kernel Space
<html>
…
<input/>
...
</html>
API Hooking
Wininet.dll
…
<input/>
...
WebInject
<input/>
Wininet.dll
Decryption
HTTPS
<html>
…
</html>
Original Page
Encryption



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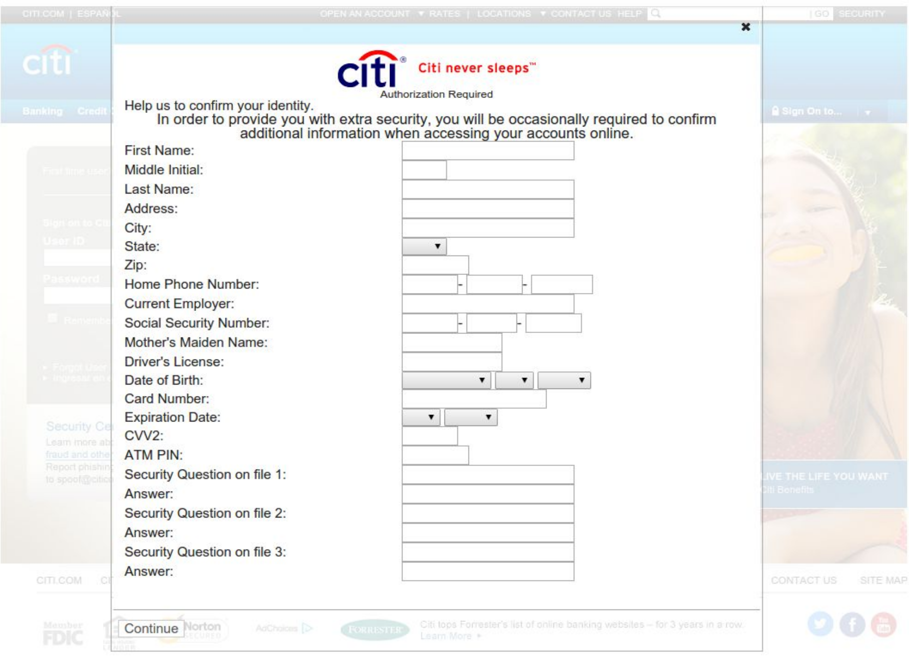

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Middle Initial:

Last Name:

Address:

City:

State: ▾

Zip:

Home Phone Number: - -

Current Employer:

Social Security Number: - -

Mother's Maiden Name:

Driver's License:

Date of Birth: ▾ ▾ ▾

Card Number:

Expiration Date: ▾ ▾

CVV2:

ATM PIN:

Security Question on file 1:

Answer:

Security Question on file 2:

Answer:

Security Question on file 3:

Answer:

Continue

Hands-on: Build a ZeuS sample!

Static Analysis Tools

- file
- readelf
- strings
- Disassembler: objdump, binary ninja, Radare2, IDA
- Decompiler: IDA

Hands-on: Static Analysis

Static Analysis

- file, strings
- Disassemble `bot.exe`
  - `objdump`
  - https://binary.ninja/
  - https://www.hex-rays.com/products/ida/
- Look for code injection techniques:
  - `CreateRemoteThread?`
- More on code injection: https://github.com/peperunas/injectopi

Dynamic Analysis Tools

- strace, ltrace
- debuggers: gdb, OllyDbg, WinDbg...
- emulators: QEMU
- sandboxes: Cuckoo http://www.cuckoosandbox.org/

Hands-on: Dynamic Analysis

Dynamic Analysis

- Install and set-up cuckoo: http://www.cuckoosandbox.org/
- Analyze `bot.exe`
- Read cuckoo's report
- Dump the memory
- Inspect the memory dump
  - Install and use volatility: https://github.com/volatilityfoundation/volatility
  - Have a look at Yara: http://virustotal.github.io/yara/
- Analyze Network Traffic

Task: Custom Analysis

Automate the extraction of the WebInject targets given a sample

1. Execute the sample
2. Open the browser
   - Interesting info are allocated into the browser's address space!
3. Dump the memory
4. Look for interesting stuff! ;-)

Too Simple?

Task: Analyze `fun.exe`

More Stuff

- https://github.com/necst/arancino
- https://github.com/rshipp/awesome-malware-analysis
- https://github.com/CheckPointSW/InviZzzible
- http://www.kernelmode.info/forum/viewtopic.php?f=11&t=3478
- https://github.com/AlicanAkyol/sems
- https://github.com/angr/angr

Analysis Completed!

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