Malware Analysis

Basic Analysis

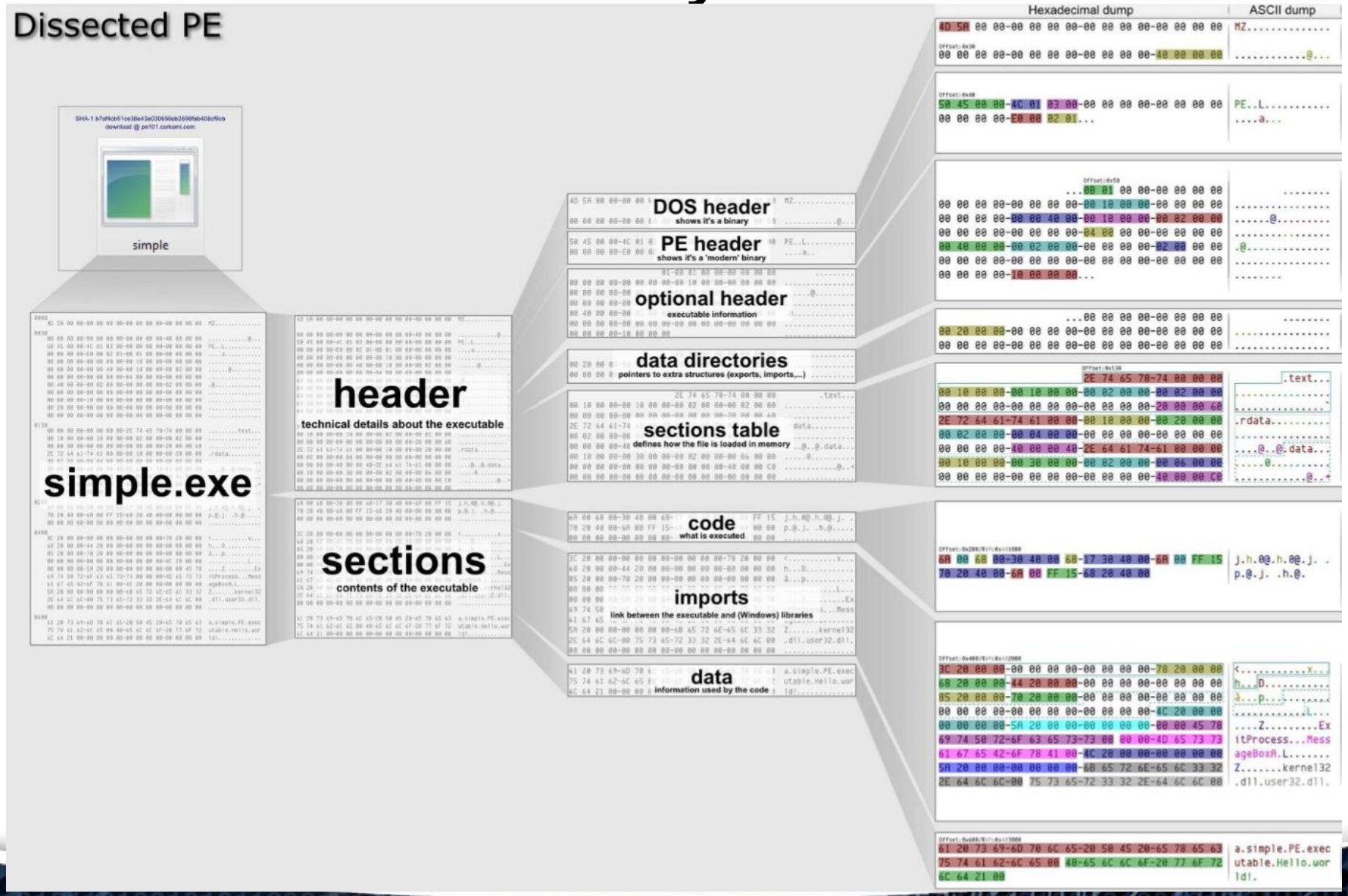
By Z-Lab team

ISWATLab

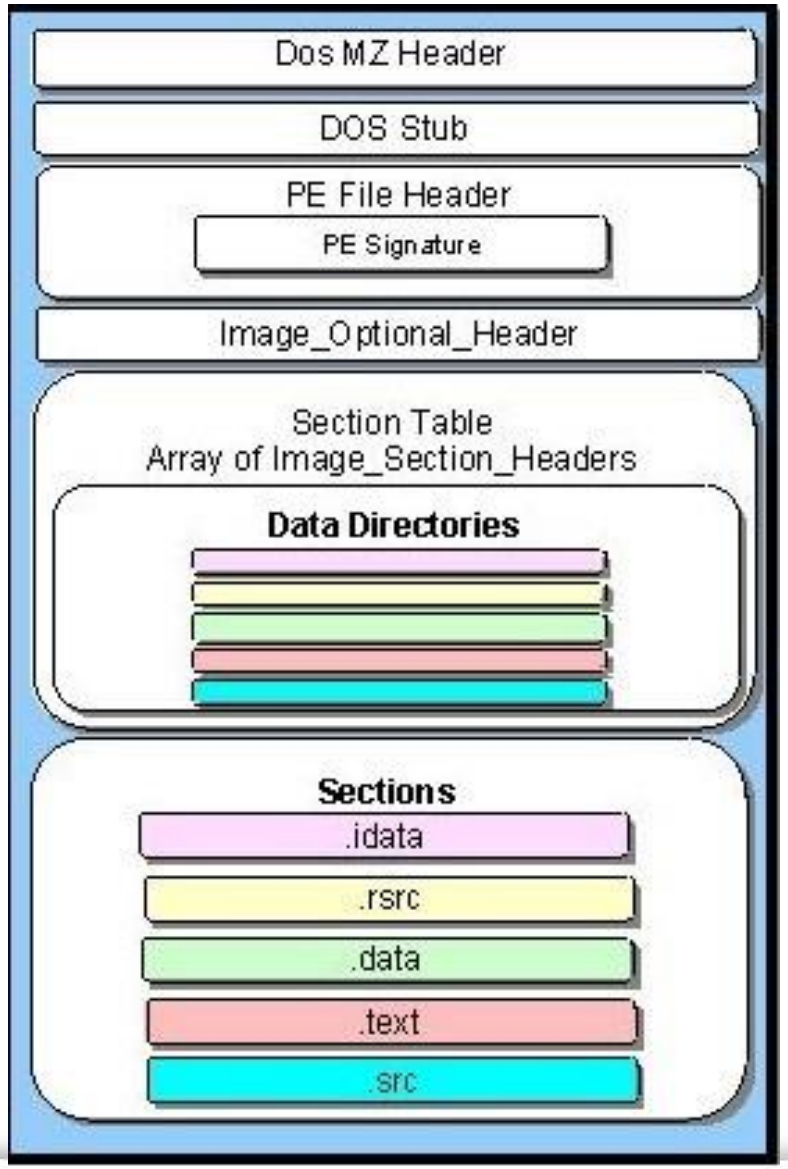
PE file format

- The Portable Executable (PE) format is a file format for executables and DLLs used in 32-bit and 64-bit versions of Windows operating system.
- The term «portable» refers to the format’s versatility in numerous environments of operating system software architecture.

PE layout


Dissected PE
simple
simple.exe
header
technical details about the executable
sections
contents of the executable
DOS header
shows it's a binary
PE header
shows it's a 'modern' binary
optional header
executable information
data directories
pointers to extra structures (exports, imports,...)
sections table
defines how the file is loaded in memory
code
what is executed
imports
link between the executable and (Windows) libraries
data
information used by the code
Hexadecimal dump
ASCII dump

PE layout

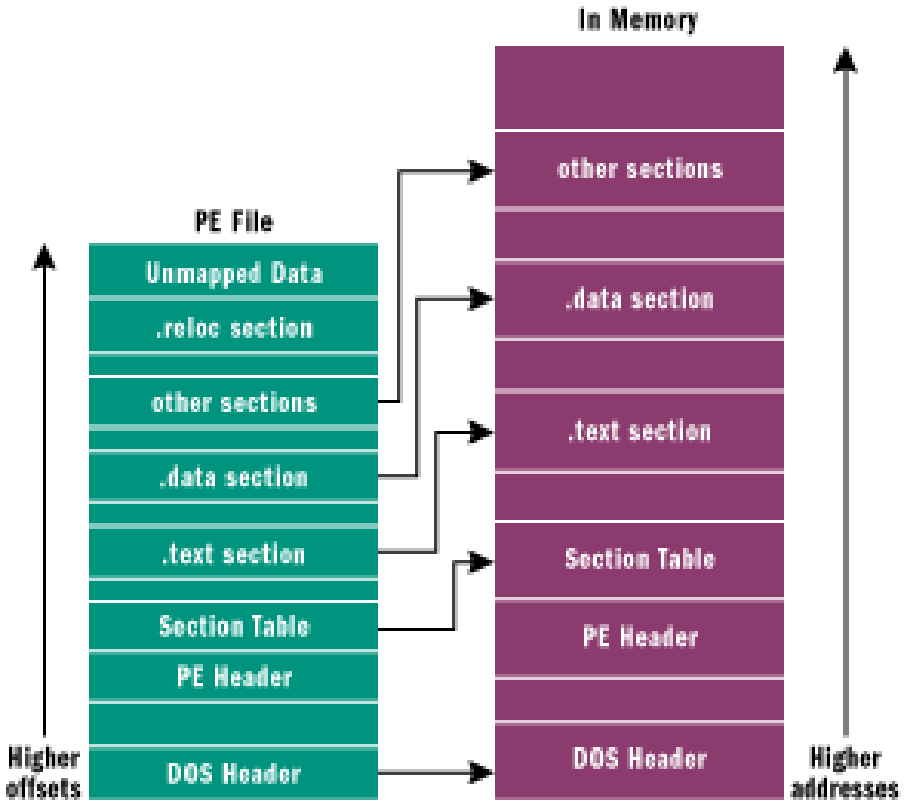

Dos MZ Header
DOS Stub
PE File Header
PE Signature
Image_Optional_Header
Section Table
Array of Image_Section_Headers
Data Directories
Sections
.idata
.rsrc
.data
.text
.src

Some sections

- .text
  - Contains the executable code
- .data
  - Contains inizialized data
- .reloc
  - Contains relocation information
- .rsrc
  - Contains resource info of a module
- .idata
  - Contains import data

Memory mapping

– Direct mapping in memory



DLL

- Dynamic-link Library
  - Shared library between many processes
  - It is a PE file with the IMAGE_FILE_DLL flag set
  - It exports some functions

- Linking a DLL:
  - Dynamic Linking: the OS loads the DLLs in memory using IAT
  - Runtime Linking: when needs the DLL, the process uses

```
dllHandle = LoadLibrary ( filename );

funcAddress = GetProcAddress ( dllHandle, functionName);

call funcAddress;
```

General Rules for Malware Analysis

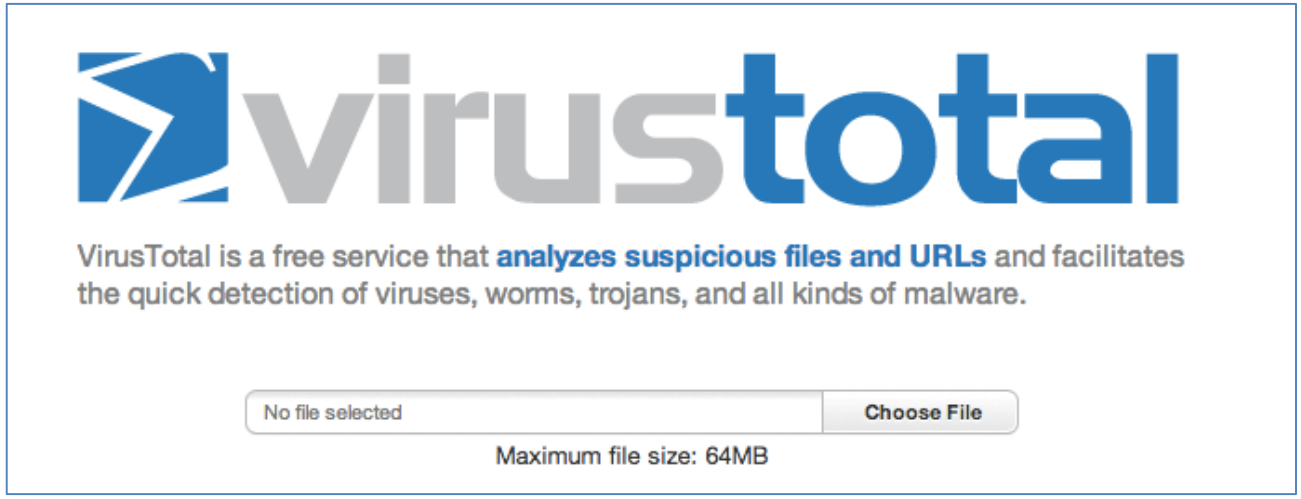
- Don’t Get Caught in Details
  - You don’t need to understand 100% of the code
  - Focus on key features
- Try Several Tools
  - If one tool fails, try another
  - Don’t get stuck on a hard issue, move along
- Malware authors are constantly raising the bar

Basic Analysis

- Basic static analysis
  - View malware without looking at instructions
  - Tools: VirusTotal, strings
  - Quick and easy but fails for advanced malware and can miss important behavior
- Basic dynamic analysis
  - Easy but requires a safe test environment
  - Not effective on all malware

Only a First Step

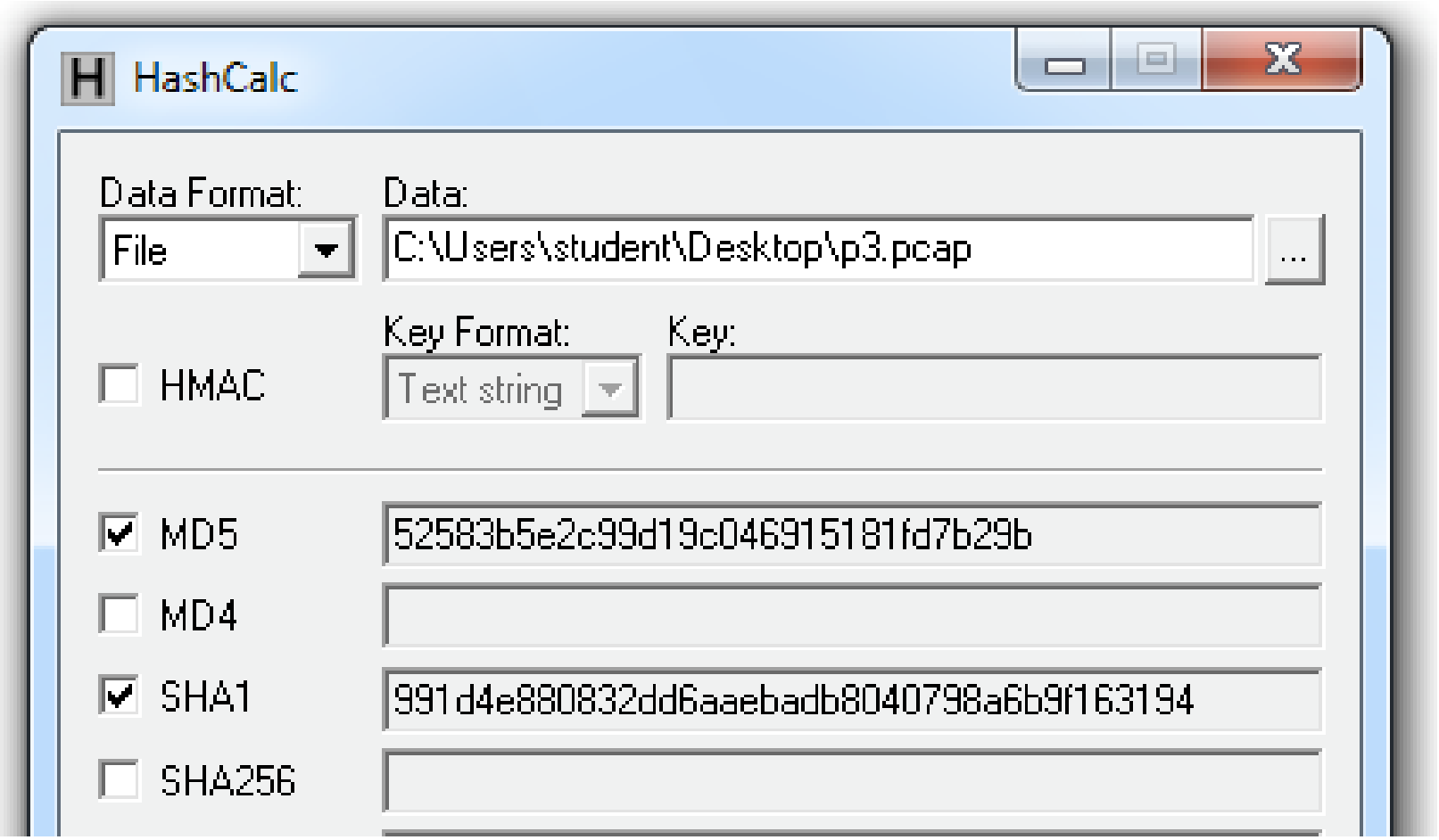
- Malware can easily change its signature and fool the antivirus
- VirusTotal is convenient, but using it may alert attackers that they've been caught



Hashes

- MD5, SHA-1, SHA-256, SHA 512
- Condenses a file of any size down to a fixed-length fingerprint
- Uniquely identifies a file well in practice
  - There are MD5 collisions but they are not common
  - Collision: two different files with the same hash
- Label a malware file
- Share the hash with other analysts to identify malware
- Search the hash online to see if someone else has already identified the file

HashCalc

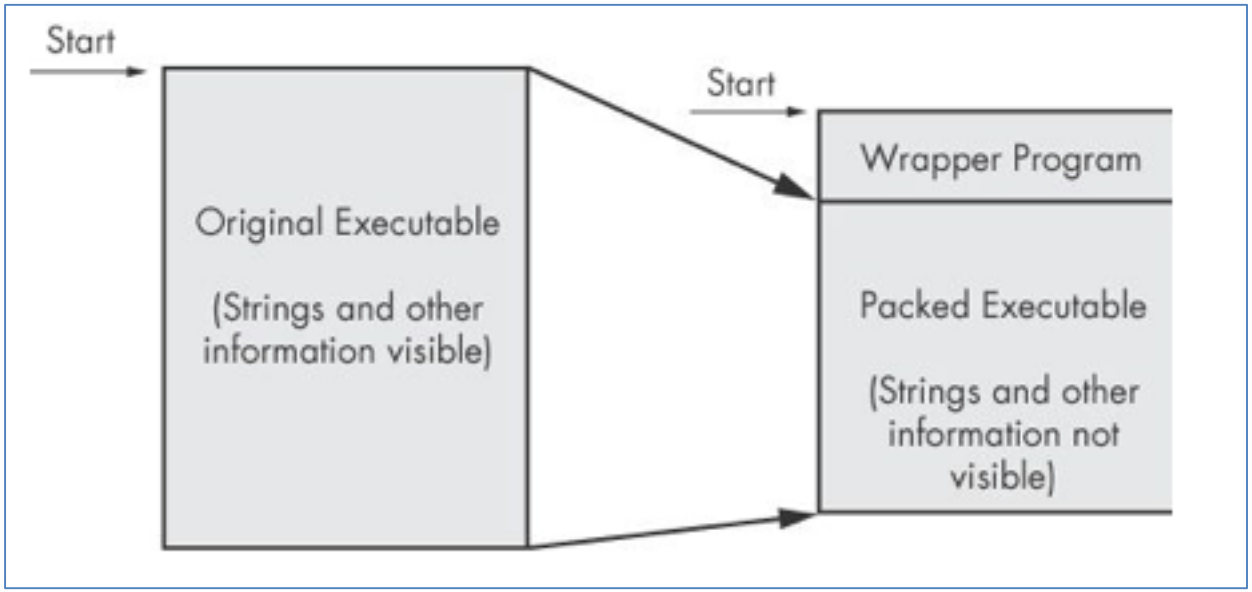

HashCalc
Data Format:
File
Data:
C:\Users\student\Desktop\p3.pcap
...
HMAC
Key Format:
Text string
Key:
MD5
52583b5e2c99d19c046915181fd7b29b
MD4
SHA1
991d4e880832dd6aaebadb8040798a6b9f163194
SHA256

Strings

- Any sequence of printable characters is a **string**
- Strings are terminated by a **null** (0x00)
- ASCII characters are 8 bits long
  - Now called ANSI
- Unicode characters are 16 bits long
  - Microsoft calls them "wide characters"

Packing Files

- The code is compressed, like a Zip file
- This makes the strings and instructions unreadable
- All you'll see is the **wrapper** – small code that unpacks the file when it is run



Detecting Packers with PEiD

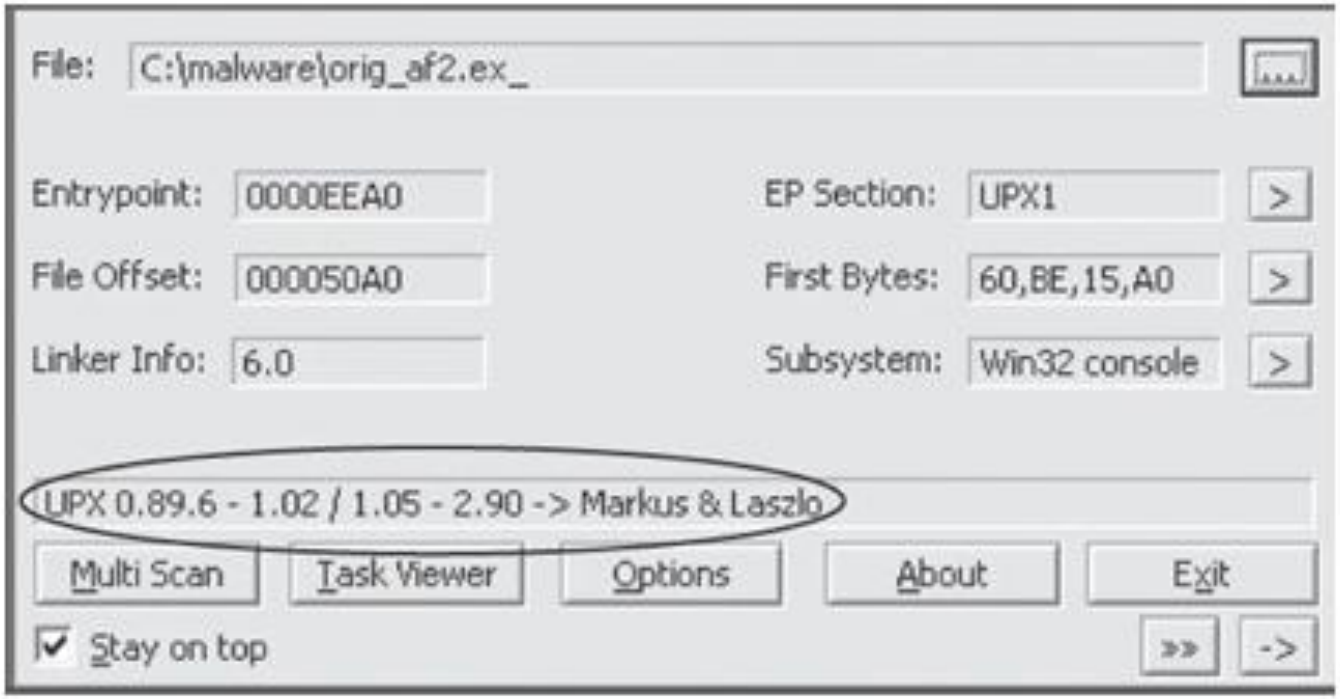
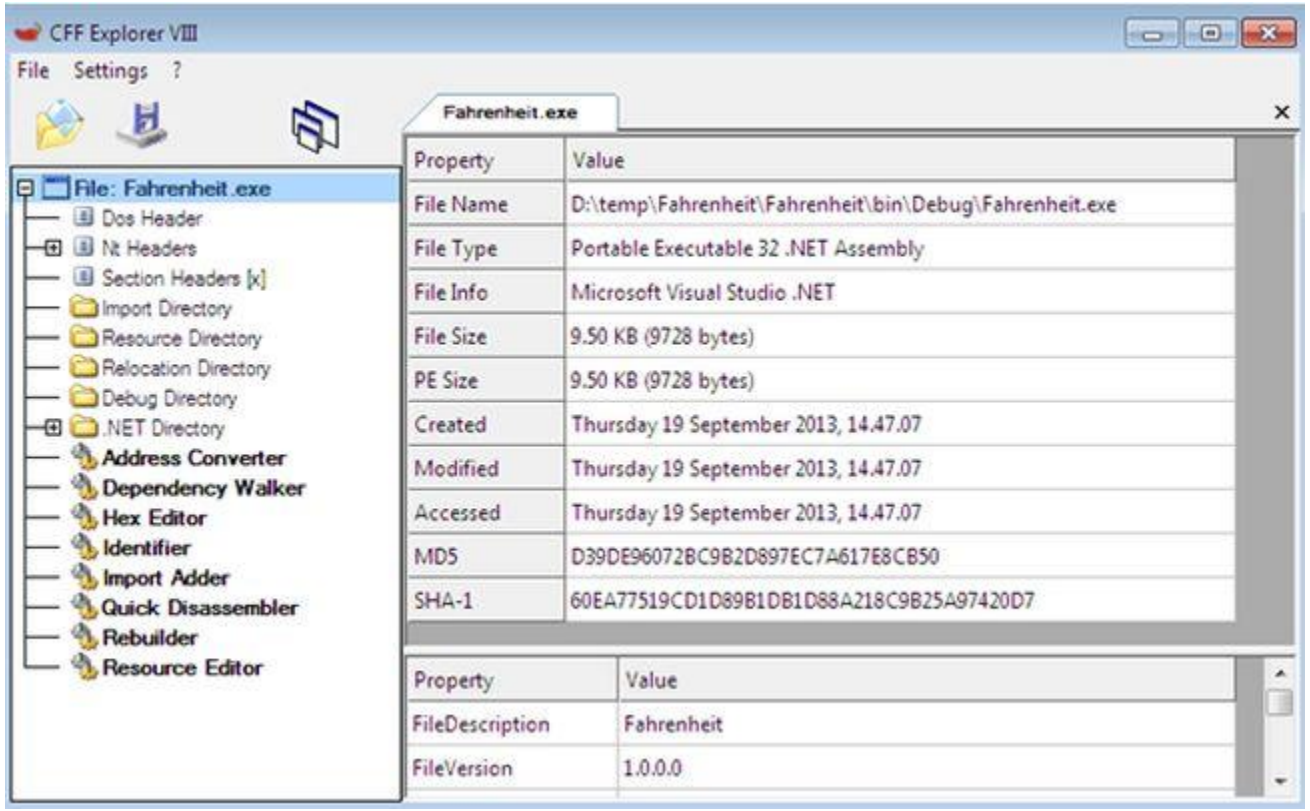


Figure 2-5. The PEiD program

CFF Explorer



Dynamic Analysis

- Static analysis can reach a dead-end, due to
  - Obfuscation
  - Packing
  - Examiner has exhausted the available static analysis techniques
- Dynamic analysis is efficient and will show you exactly what the malware does

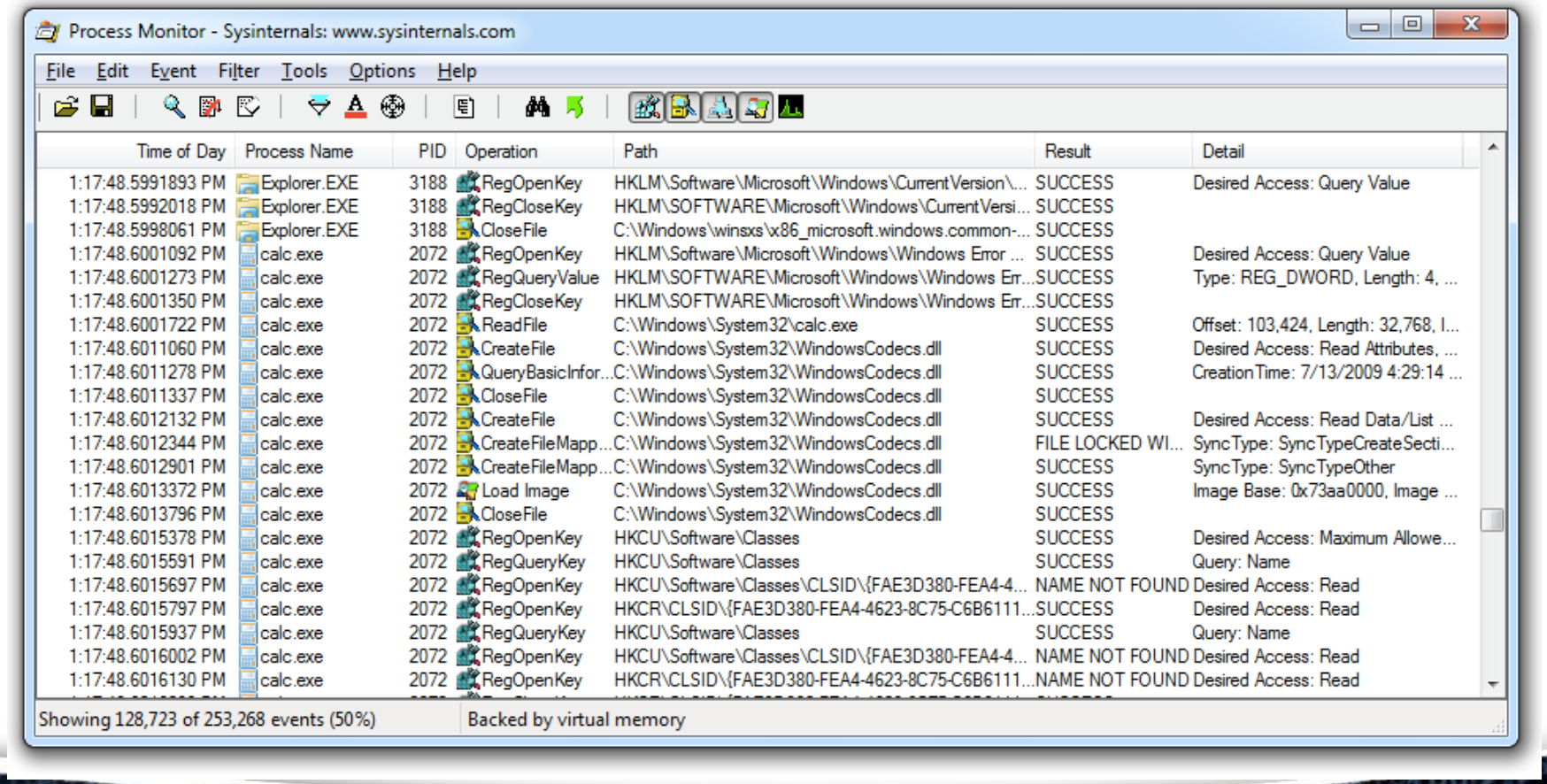
Sandbox

- All-in-one software for basic dynamic analysis
- Virtualized environment that simulates network services
- Examples: Joe Sandbox, ThreatExpert, BitBlaze, Cuckoo Sandbox, Hybrid Analysis
- They produce a report of results

Process Monitor

- Monitors registry, file system, network, process, and thread activity
- All recorded events are kept, but you can filter the display to make it easier to find items of interest
- Don't run it too long or it will fill up all RAM and crash the machine

Procmon



Time of Day	Process Name	PID	Operation	Path	Result	Detail
1:17:48.5991893 PM	Explorer.EXE	3188	RegOpenKey	HKLM\Software\Microsoft\Windows\CurrentVersion\...	SUCCESS	Desired Access: Query Value
1:17:48.5992018 PM	Explorer.EXE	3188	RegCloseKey	HKLM\SOFTWARE\Microsoft\Windows\CurrentVersi...	SUCCESS	
1:17:48.5998061 PM	Explorer.EXE	3188	CloseFile	C:\Windows\winsxs\x86_microsoft.windows.common-...	SUCCESS	
1:17:48.6001092 PM	calc.exe	2072	RegOpenKey	HKLM\Software\Microsoft\Windows\Windows Error ...	SUCCESS	Desired Access: Query Value
1:17:48.6001273 PM	calc.exe	2072	RegQueryValue	HKLM\SOFTWARE\Microsoft\Windows\Windows Err...	SUCCESS	Type: REG_DWORD, Length: 4, ...
1:17:48.6001350 PM	calc.exe	2072	RegCloseKey	HKLM\SOFTWARE\Microsoft\Windows\Windows Err...	SUCCESS	
1:17:48.6001722 PM	calc.exe	2072	ReadFile	C:\Windows\System32\calc.exe	SUCCESS	Offset: 103,424, Length: 32,768, I...
1:17:48.6011060 PM	calc.exe	2072	CreateFile	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	Desired Access: Read Attributes, ...
1:17:48.6011278 PM	calc.exe	2072	QueryBasicInfor...	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	CreationTime: 7/13/2009 4:29:14 ...
1:17:48.6011337 PM	calc.exe	2072	CloseFile	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	
1:17:48.6012132 PM	calc.exe	2072	CreateFile	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	Desired Access: Read Data/List ...
1:17:48.6012344 PM	calc.exe	2072	CreateFileMapp...	C:\Windows\System32\WindowsCodecs.dll	FILE LOCKED WI...	SyncType: SyncTypeCreateSecti...
1:17:48.6012901 PM	calc.exe	2072	CreateFileMapp...	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	SyncType: SyncTypeOther
1:17:48.6013372 PM	calc.exe	2072	Load Image	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	Image Base: 0x73aa0000, Image ...
1:17:48.6013796 PM	calc.exe	2072	CloseFile	C:\Windows\System32\WindowsCodecs.dll	SUCCESS	
1:17:48.6015378 PM	calc.exe	2072	RegOpenKey	HKCU\Software\Classes	SUCCESS	Desired Access: Maximum Allowe...
1:17:48.6015591 PM	calc.exe	2072	RegQueryKey	HKCU\Software\Classes	SUCCESS	Query: Name
1:17:48.6015697 PM	calc.exe	2072	RegOpenKey	HKCU\Software\Classes\CLSID\{FAE3D380-FEA4-4...	NAME NOT FOUND	Desired Access: Read
1:17:48.6015797 PM	calc.exe	2072	RegOpenKey	HKCR\CLSID\{FAE3D380-FEA4-4623-8C75-C6B6111...	SUCCESS	Desired Access: Read
1:17:48.6015937 PM	calc.exe	2072	RegQueryKey	HKCU\Software\Classes	SUCCESS	Query: Name
1:17:48.6016002 PM	calc.exe	2072	RegOpenKey	HKCU\Software\Classes\CLSID\{FAE3D380-FEA4-4...	NAME NOT FOUND	Desired Access: Read
1:17:48.6016130 PM	calc.exe	2072	RegOpenKey	HKCR\CLSID\{FAE3D380-FEA4-4623-8C75-C6B6111...	NAME NOT FOUND	Desired Access: Read

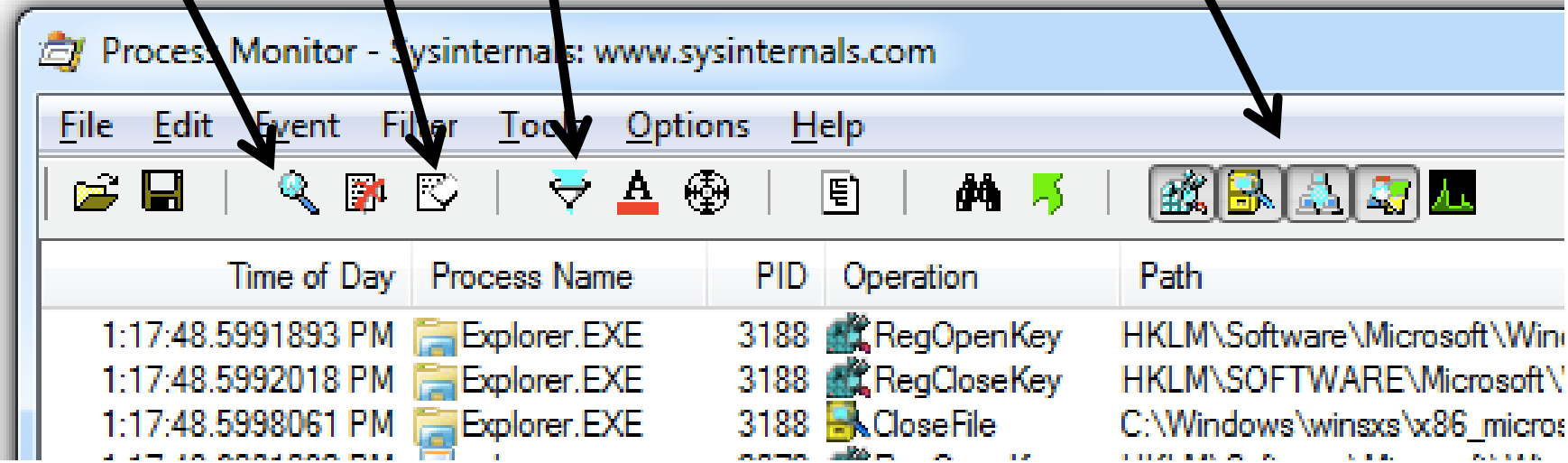
Process Monitor Toolbar

Start/Stop Capture

Erase

Filter

Default Filters
Registry, File system, Network, Processes



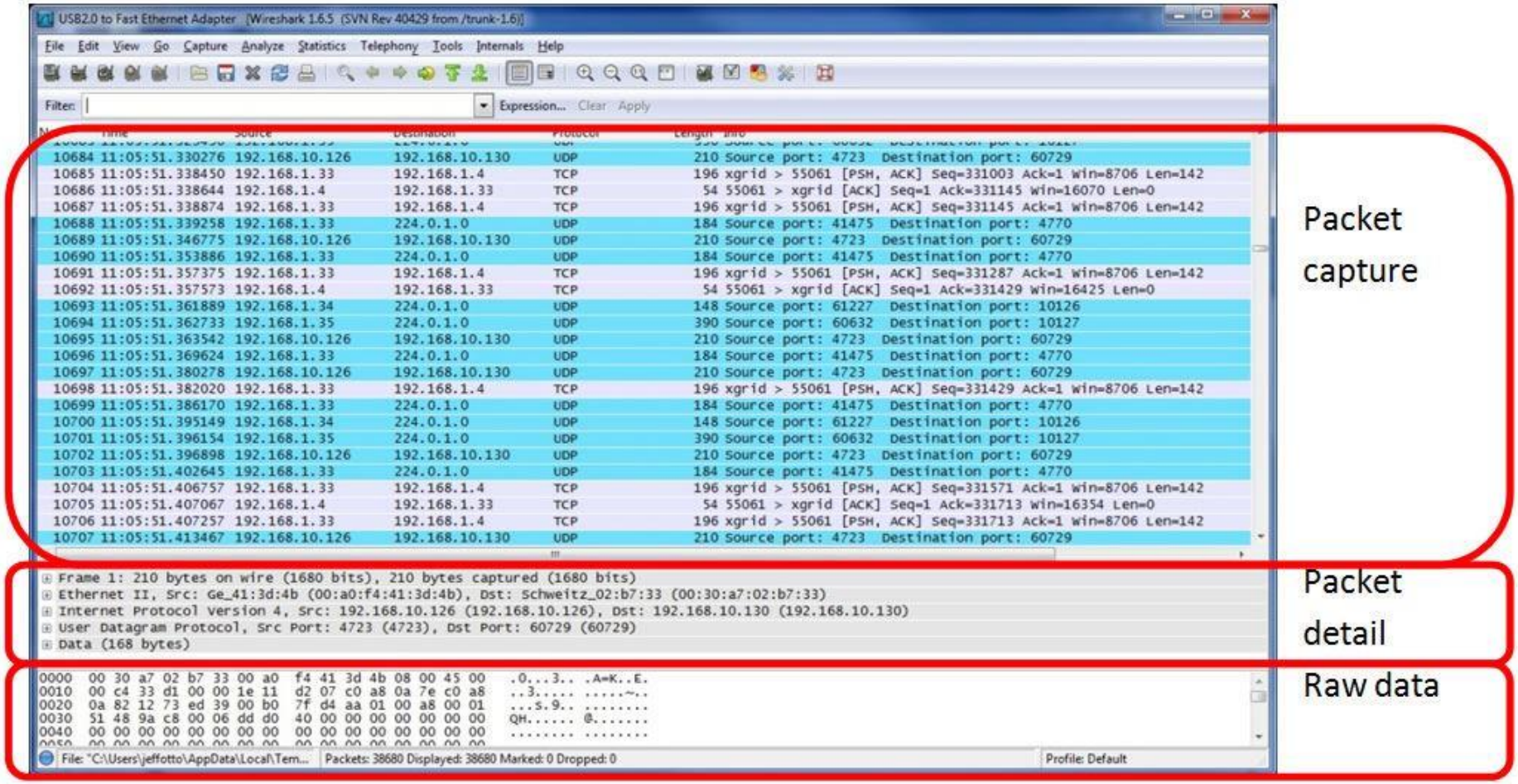
Process Explorer - Sysinternals: www.sysinternals.com [W7\student]

File Options View Process Find Users Help

Process	PID	CPU	Private Bytes	Working Set	Description	Company Name
System Idle Process	0	96.81	0 K	24 K		
System	4	0.09	48 K	560 K		
Interrupts	n/a	0.88	0 K	0 K	Hardware Interrupts and DPCs	
smss.exe	260		224 K	748 K	Windows Session Manager	Microsoft Corporation
csrss.exe	348	< 0.01	1,252 K	3,164 K	Client Server Runtime Process	Microsoft Corporation
wininit.exe	400		892 K	3,084 K	Windows Start-Up Application	Microsoft Corporation
services.exe	504	0.01	3,972 K	6,640 K	Services and Controller app	Microsoft Corporation
svchost.exe	652		2,700 K	6,024 K	Host Process for Windows S...	Microsoft Corporation
dllhost.exe	1716		6,176 K	4,804 K	COM Surrogate	Microsoft Corporation
WmiPrvSE.exe	740		1,804 K	4,736 K	WMI Provider Host	Microsoft Corporation
svchost.exe	724	< 0.01	2,972 K	6,012 K	Host Process for Windows S...	Microsoft Corporation
svchost.exe	772		13,776 K	11,760 K	Host Process for Windows S...	Microsoft Corporation
audiodg.exe	3200		14,960 K	13,972 K	Windows Audio Device Grap...	Microsoft Corporation
svchost.exe	912		37,940 K	42,292 K	Host Process for Windows S...	Microsoft Corporation
dwm.exe	3248	0.74	61,892 K	27,976 K	Desktop Window Manager	Microsoft Corporation
svchost.exe	936	0.02	20,836 K	29,900 K	Host Process for Windows S...	Microsoft Corporation
svchost.exe	1116	0.03	5,136 K	8,340 K	Host Process for Windows S...	Microsoft Corporation
svchost.exe	1260	0.06	10,840 K	11,960 K	Host Process for Windows S...	Microsoft Corporation
spoolsv.exe	1352		5,392 K	7,436 K	Spooler SubSystem App	Microsoft Corporation
svchost.exe	1388		6,752 K	8,720 K	Host Process for Windows S...	Microsoft Corporation
svchost.exe	1500		2,472 K	4,712 K	Host Process for Windows S...	Microsoft Corporation
gogoc.exe	1592	< 0.01	1,216 K	3,920 K	gogoCLIENT	gogo6, Inc.
vmtoolsd.exe	1728	0.07	7,260 K	10,368 K	VMware Tools Core Service	VMware, Inc.
svchost.exe						

CPU Usage: 3.19% | Commit Charge: 21.92% | Processes: 57 | Physical Usage: 30.24%

Wireshark



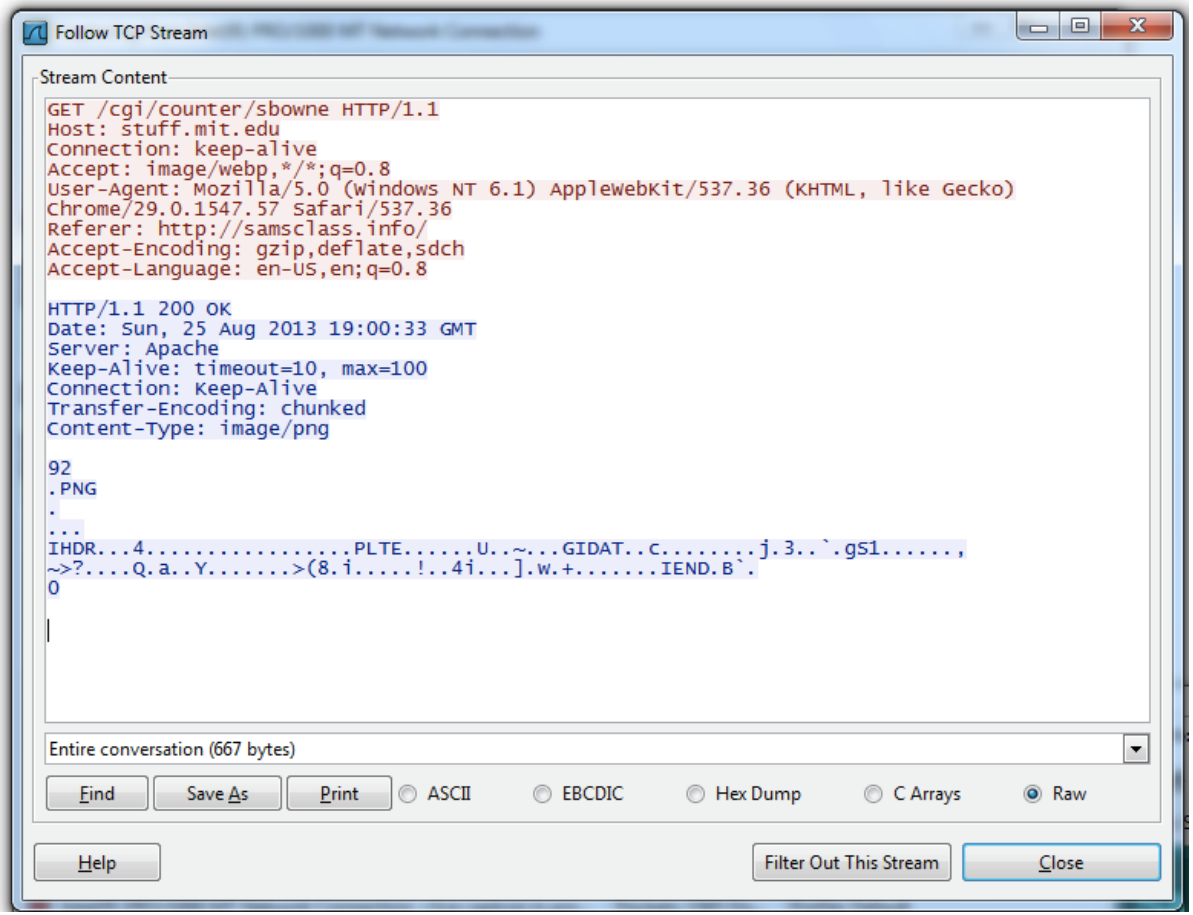
Packet capture

Packet detail

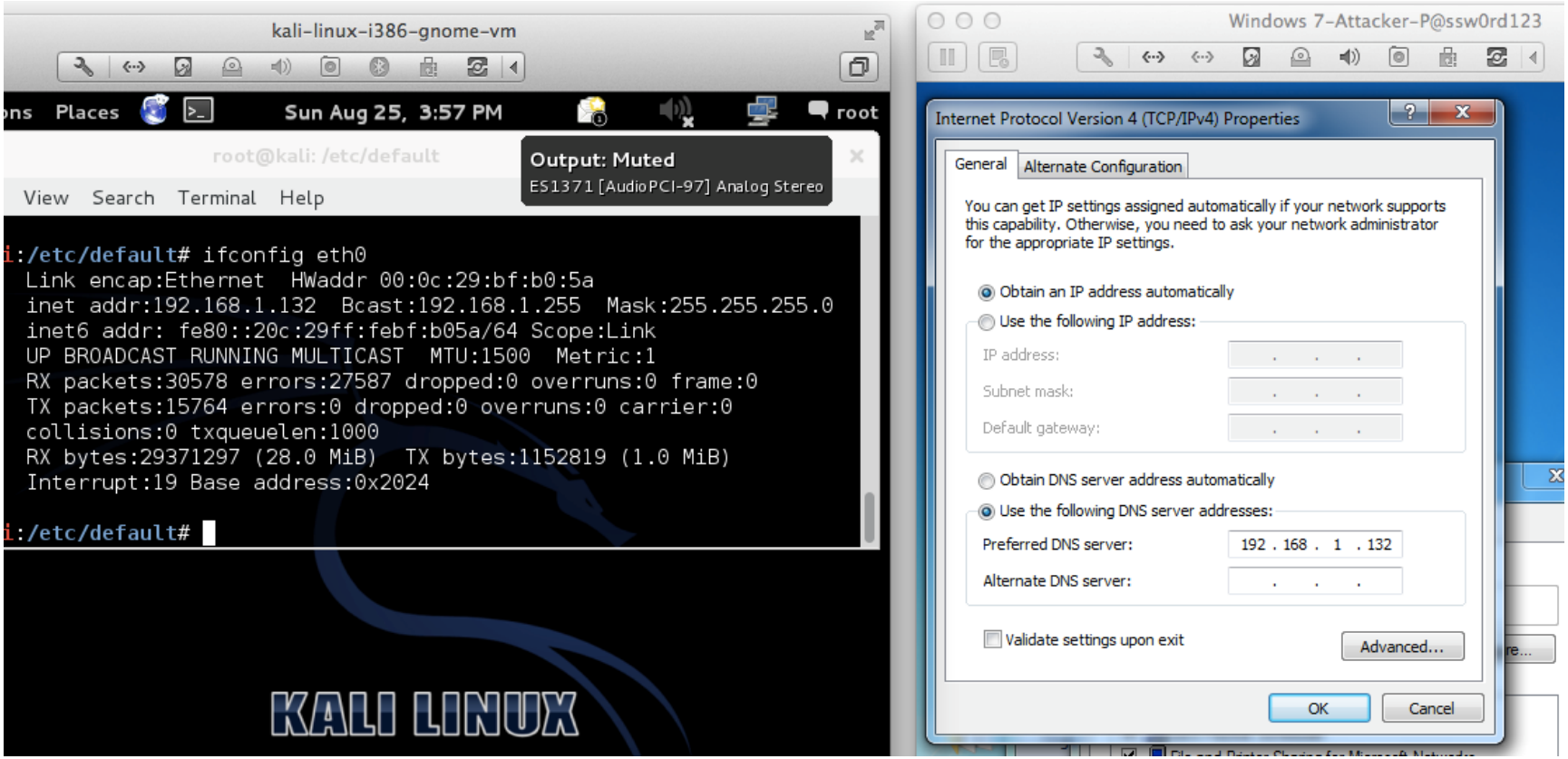
Raw data

Follow TCP Stream

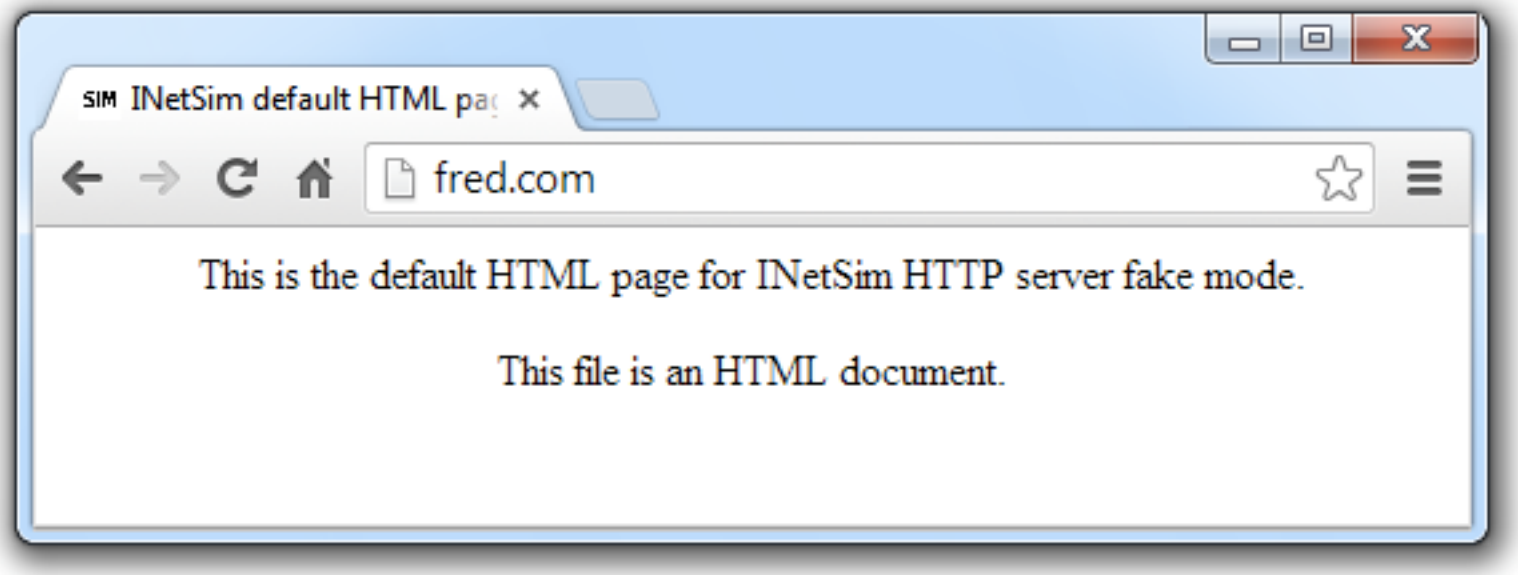
- Can safe files from streams here too



inetsim


kali-linux-i386-gnome-vm
Places
Sun Aug 25, 3:57 PM
root
root@kali: /etc/default
Output: Muted
ES1371 [AudioPCI-97] Analog Stereo
View Search Terminal Help
i:/etc/default# ifconfig eth0
Link encap:Ethernet HWaddr 00:0c:29:bf:b0:5a
inet addr:192.168.1.132 Bcast:192.168.1.255 Mask:255.255.255.0
inet6 addr: fe80::20c:29ff:febf:b05a/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:30578 errors:27587 dropped:0 overruns:0 frame:0
TX packets:15764 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:29371297 (28.0 MiB) TX bytes:1152819 (1.0 MiB)
Interrupt:19 Base address:0x2024
i:/etc/default#
KALI LINUX
Windows 7-Attacker-P@ssw0rd123
Internet Protocol Version 4 (TCP/IPv4) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
Subnet mask:
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server: 192 . 168 . 1 . 132
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

INetSim Fools a Browser



Using the Tools

- Procmon
  - Filter on the malware executable name and clear all events just before running it
- Process Explorer
- Regshot
- Virtual Network with INetSim
- Wireshark

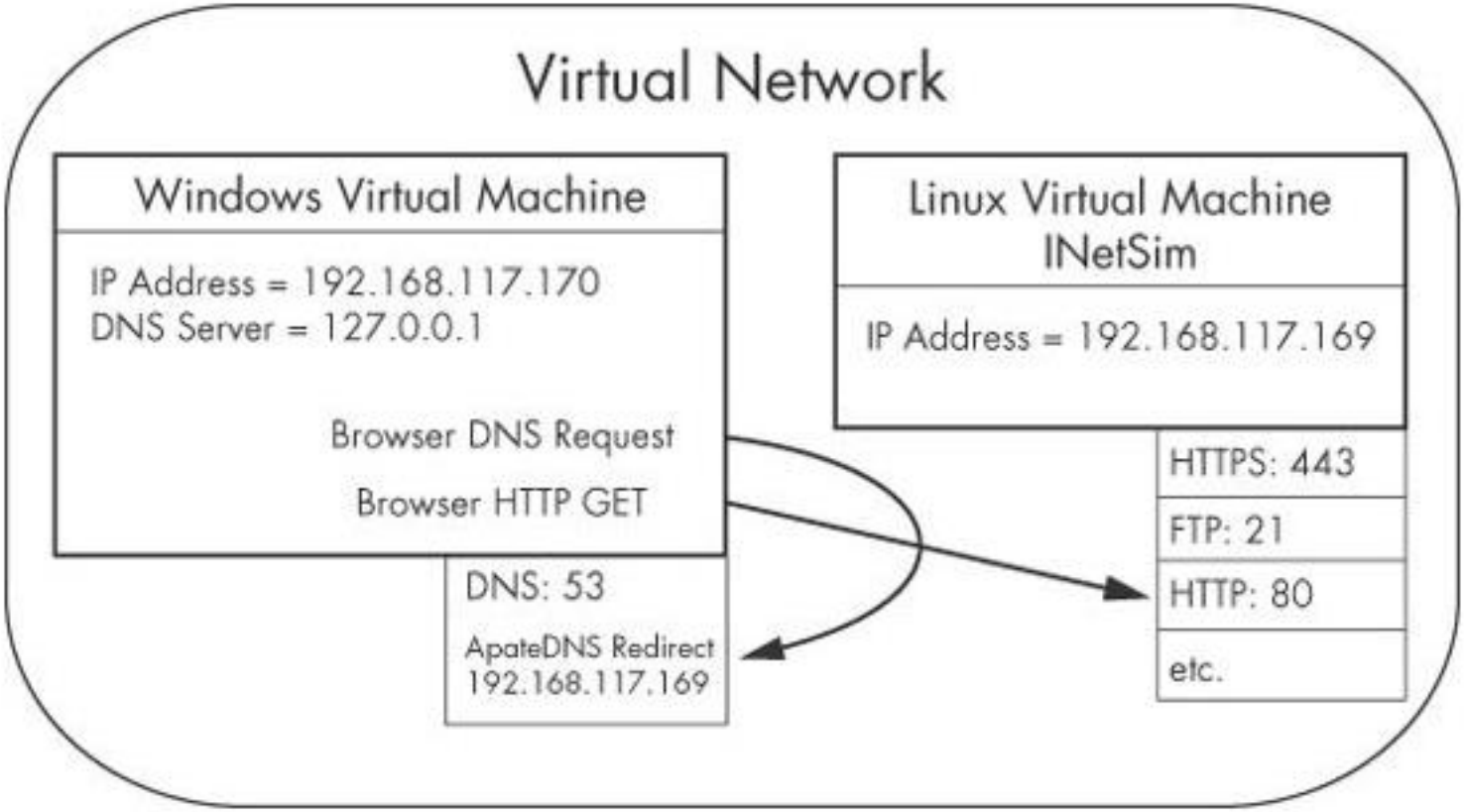


Figure 4-12. Example of a virtual network