Forensic Investigation & Malware Analysis against Targeted Attack using Free Tools

IIJ Internet Initiative Japan

2013/1/30

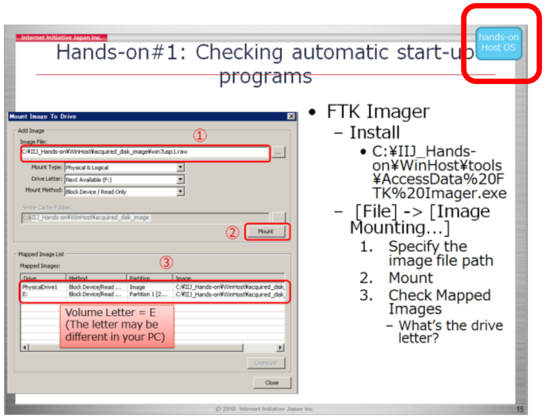
IIJ-SECT
Internet Initiative Japan Inc.

Ongoing Innovation

Setup Instructions

- Copy the files in USB flash memory
  - Copy “IIJ_Hands-on” to “C:¥” of your laptop (Host OS)
    - leaked_file
      - 7z file including documents leaked during this incident
    - WinHost
      - Data and tools used on host OS
    - WinVM
      - Data and tools used on Windows VM
    - Documents
      - Hands-on PDF and its answer PDFs (password protected)
      - references for forensic investigation
  - NOTICE: “¥” stands for backslash in Japanese OS
- Extract the disk image
  - C:¥IIJ_Hands-on¥WinHost¥acquired_disk_image¥win7usp1.zip
    - Vista and 7 users: Use “Extract all files” of OS function
    - XP users: Install 7-Zip and use it
      - C:¥IIJ_Hands-on¥WinHost¥tools¥7z920.exe
  - DELETE the image after your hands-on!!

IMPORTANT: Hands-on Mark



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Hands-on#1: Checking automatic start-up programs

hands-on Host OS

Mount Image To Drive

Add Image

Image File: C:¥IIJ_Hands-on¥WinHost¥acquired_disk_image¥win7usp1.raw

Mount Type: Physical & Logical

Drive Letter: Next Available (F:)

Mount Method: Block Device / Read Only

Write Cache Folder: C:¥IIJ_Hands-on¥WinHost¥acquired_disk_image

Mapped Image List

Mapped Images:

Drive	Method	Partition	Image
PhysicalDrive1	Block Device/Read ...	Image	C:¥IIJ_Hands-on¥WinHost¥acquired_disk_
E:	Block Device/Read ...	Partition 1 [2...	C:¥IIJ_Hands-on¥WinHost¥acquired_disk_

Volume Letter = E (The letter may be different in your PC)

- FTK Imager
  - Install
    - C:¥IIJ_Hands-on¥WinHost¥tools¥AccessData%20FTK%20Imager.exe
  - [File] -> [Image Mounting…]
    1. Specify the image file path
    2. Mount
    3. Check Mapped Images
       - What's the drive letter?

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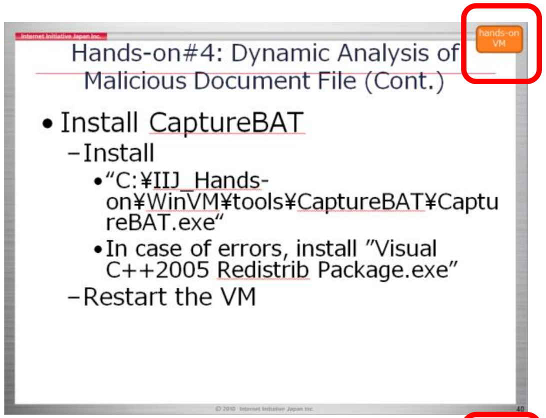
hands-on Host OS

Work on something in your host OS



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Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

hands-on VM

- Install CaptureBAT
  - Install
    - "C:¥IIJ_Hands-on¥WinVM¥tools¥CaptureBAT¥CaptureBAT.exe"
    - In case of errors, install "Visual C++2005 Redistrib Package.exe"
  - Restart the VM

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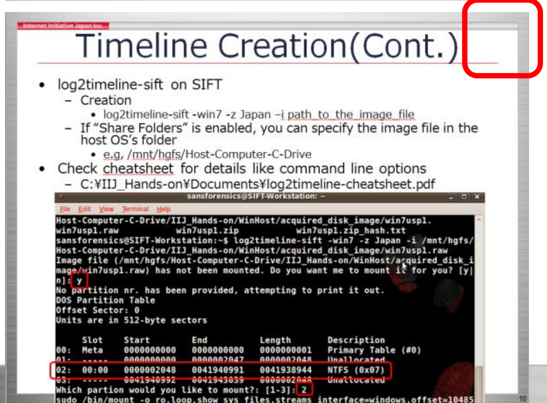
hands-on VM

Work on something in your guest OS



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Timeline Creation(Cont.)

- log2timeline-sift on SIFT
  - Creation
    - log2timeline-sift -win7 -z Japan –i path_to_the_image_file
  - If "Share Folders" is enabled, you can specify the image file in the host OS's folder
    - e.g, /mnt/hgfs/Host-Computer-C-Drive
- Check cheatsheet for details like command line options
  - C:¥IIJ_Hands-on¥Documents¥log2timeline-cheatsheet.pdf

sansforensics@SIFT-Workstation: ~

```
Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_image/win7uspl.
win7uspl.raw          win7uspl.zip          win7uspl.zip_hash.txt
sansforensics@SIFT-Workstation:~$ log2timeline-sift -win7 -z Japan -i /mnt/hgfs/
Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_image/win7uspl.raw
Image file (/mnt/hgfs/Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_i
mage/win7uspl.raw) has not been mounted. Do you want me to mount it for you? [y|
n]: y
No partition nr. has been provided, attempting to print it out.
DOS Partition Table
Offset Sector: 0
Units are in 512-byte sectors

     Slot    Start        End          Length       Description
00:  Meta    0000000000   0000000000   0000000001   Primary Table (#0)
01:  -----   0000000000   0000002047   0000002048   Unallocated
02:  00:00   0000002048   0041940991   0041938944   NTFS (0x07)
03:  -----   0041940992   0041943039   0000002048   Unallocated
Which partion would you like to mount?: [1-3]: 2
sudo /bin/mount -o ro,loop,show_sys_files,streams_interface=windows,offset=10485
```

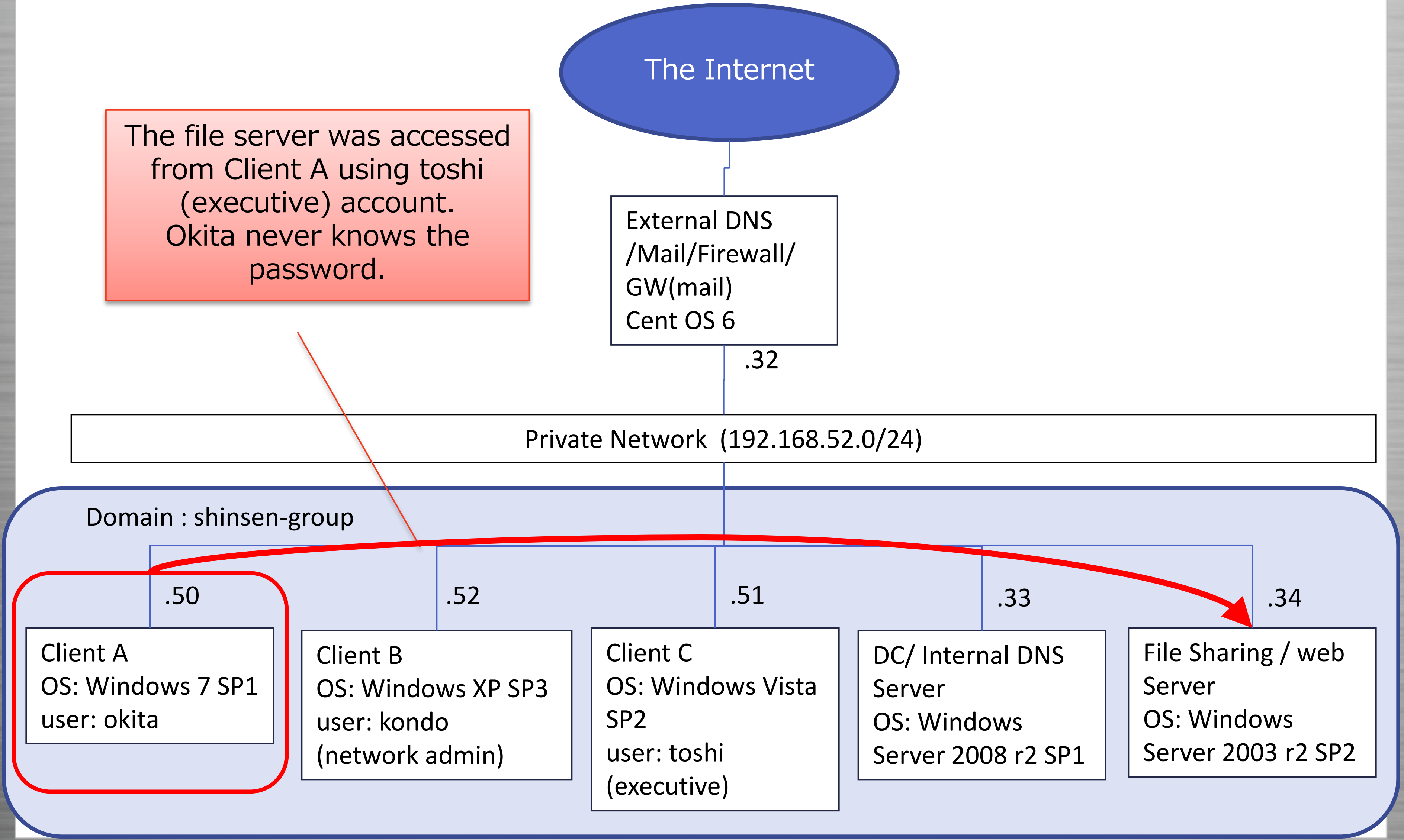
10

Just look

Scenario

- You are a member of CSIRT at a certain company
- You were externally-pointed out information of your company leaked
  - The leaked private documents were uploaded on the Internet
  - The file name is “a.7z”
- You identified the suspicious PC from the following evidences
  - file sharing server’s event logs
  - interview outcome of clients
- That’s why you decided to examine the PC

Network Configuration



The file server was accessed from Client A using toshi (executive) account. Okita never knows the password.

The Internet

External DNS /Mail/Firewall/ GW(mail)
Cent OS 6

.32

Private Network (192.168.52.0/24)

Domain : shinsen-group

.50
Client A
OS: Windows 7 SP1
user: okita

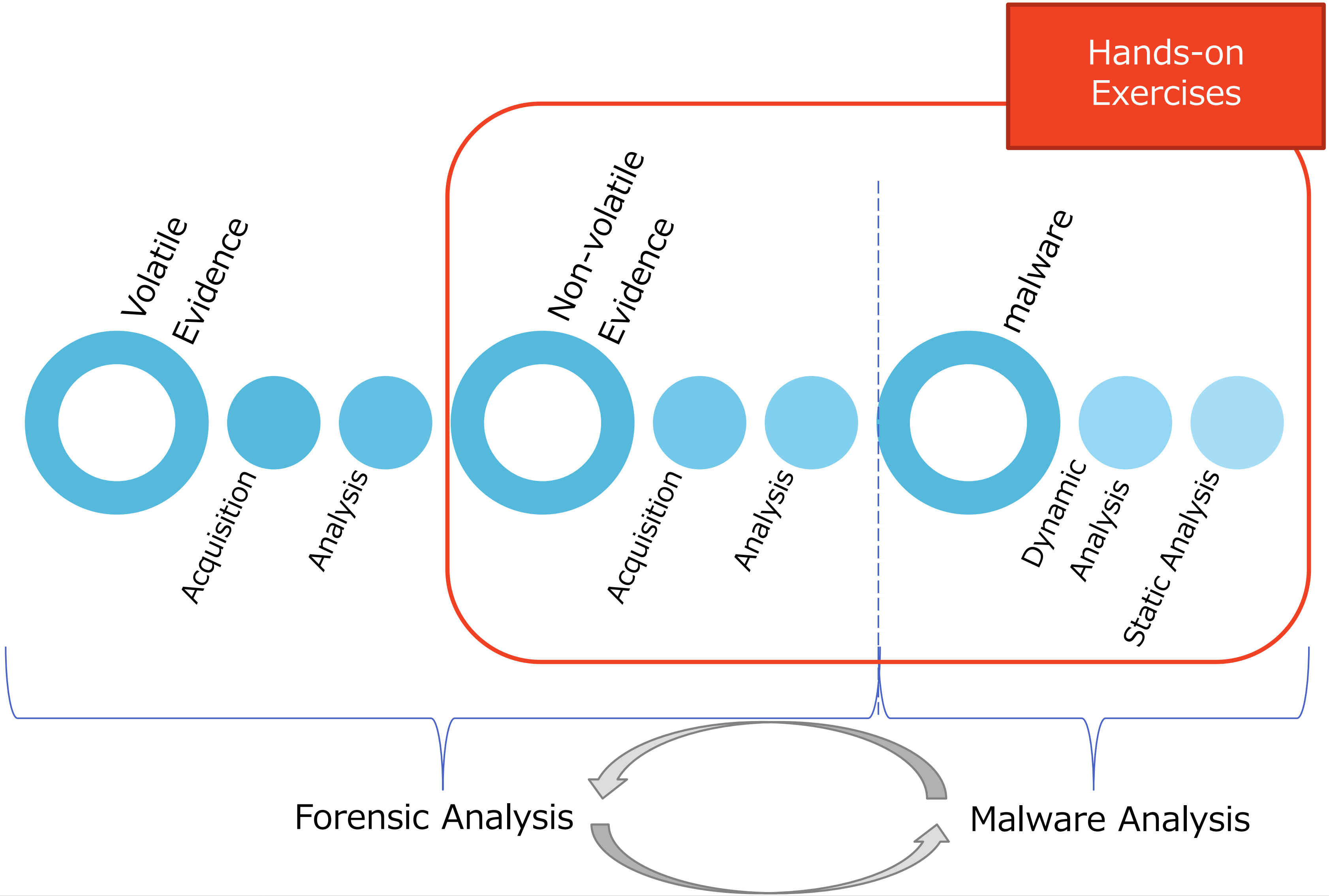
.52
Client B
OS: Windows XP SP3
user: kondo
(network admin)

.51
Client C
OS: Windows Vista SP2
user: toshi
(executive)

.33
DC/ Internal DNS Server
OS: Windows Server 2008 r2 SP1

.34
File Sharing / web Server
OS: Windows Server 2003 r2 SP2

Flow of Incident Response



Analysis in the Case

- Timeline Creation
- Root Cause Analysis of Malware Infection
  - Checking automatic start-up programs (Hands-on#1)
  - Identifying Malware Installation Time (Hands-on#2)
  - Timeline Analysis (Hands-on#3)
  - Analysis of Malicious Document File (Hands-on#4, Hands-on#5)
  - Analysis of Shellcode and Malware
  - Result
- Analysis of Post-infection Activities (Bonus Hands-on)
  - Investigating Attacker's Activity
  - Analyzing Unknown Binary
- Wrap-up

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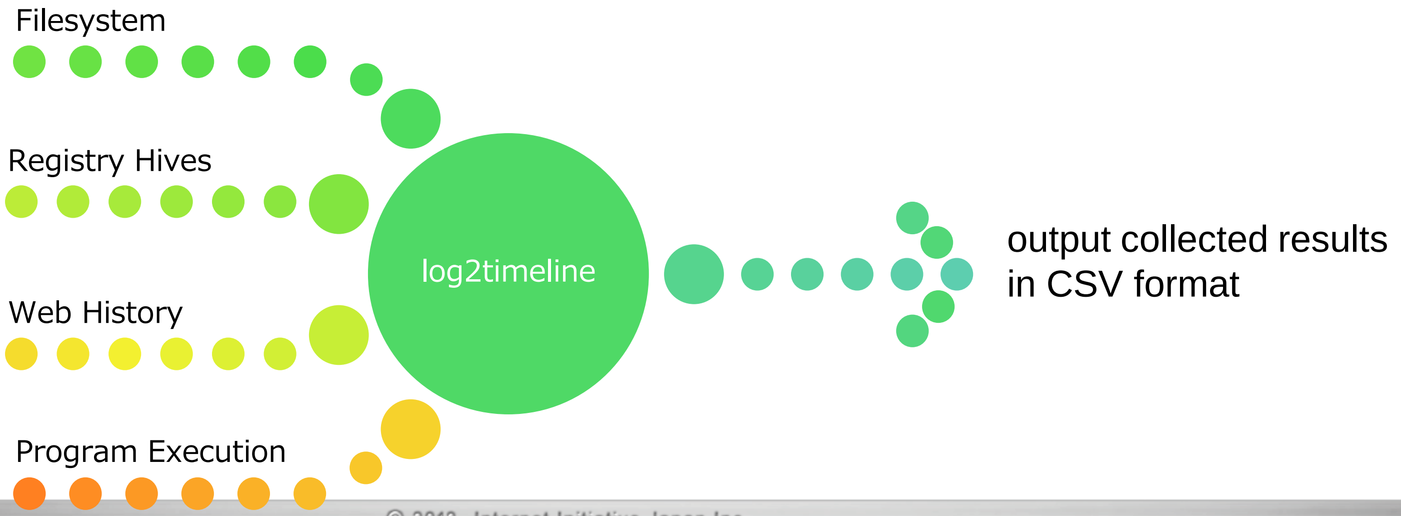
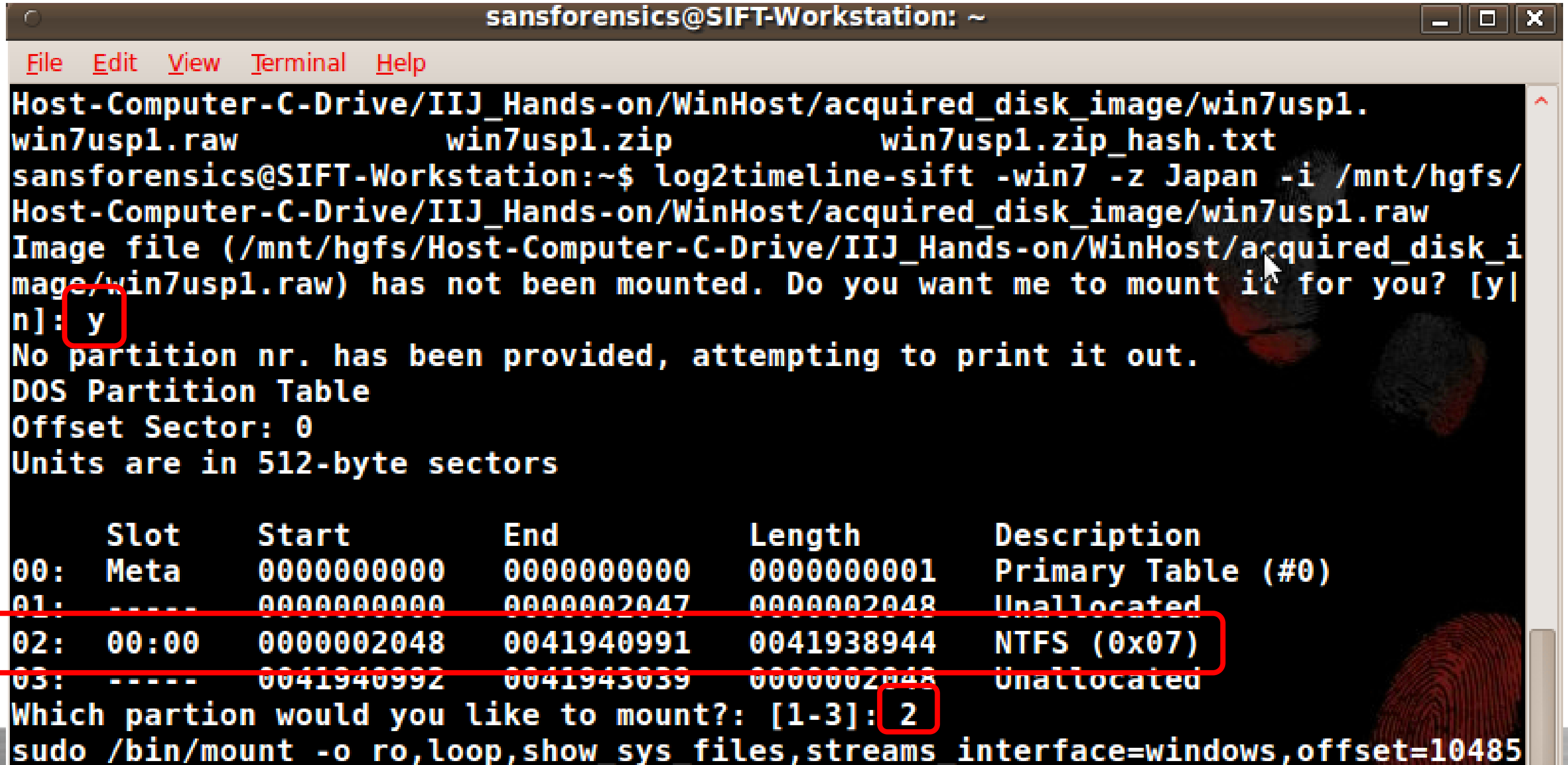
Timeline Creation

- Create Timeline using log2timeline on SANS SIFT Workstation
  - Put together various timestamps (e.g., filesystem, registry) into one output form
- Narrow down time period of malware infection by using some information
  - Find malware infection signs (e.g., start-up locations, execution history caches)
  - Use external information (e.g., malicious URLs, IPS logs)
- Check the time period
  - Trace back from the period for infection root cause
  - Follow malicious activities after the period



Timeline Creation(Cont.)

- log2timeline-sift on SANS SIFT Workstation
  - Creation
    - log2timeline-sift -win7 -z Japan –i path_to_the_image_file
  - If “Share Folders” is enabled, you can specify the image file in the host OS’s folder
    - e.g, /mnt/hgfs/Host-Computer-C-Drive
- Check cheatsheet for details like command line options
  - C:¥IIJ_Hands-on¥Documents¥log2timeline-cheatsheet.pdf


sansforensics@SIFT-Workstation: ~
File Edit View Terminal Help

```
Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_image/win7usp1.
win7usp1.raw           win7usp1.zip           win7usp1.zip_hash.txt
sansforensics@SIFT-Workstation:~$ log2timeline-sift -win7 -z Japan -i /mnt/hgfs/
Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_image/win7usp1.raw
Image file (/mnt/hgfs/Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_i
mage/win7usp1.raw) has not been mounted. Do you want me to mount it for you? [y|
n]: y
No partition nr. has been provided, attempting to print it out.
DOS Partition Table
Offset Sector: 0
Units are in 512-byte sectors

     Slot    Start        End          Length       Description
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Which partion would you like to mount?: [1-3]: 2
sudo /bin/mount -o ro,loop,show_sys_files,streams_interface=windows,offset=10485
```
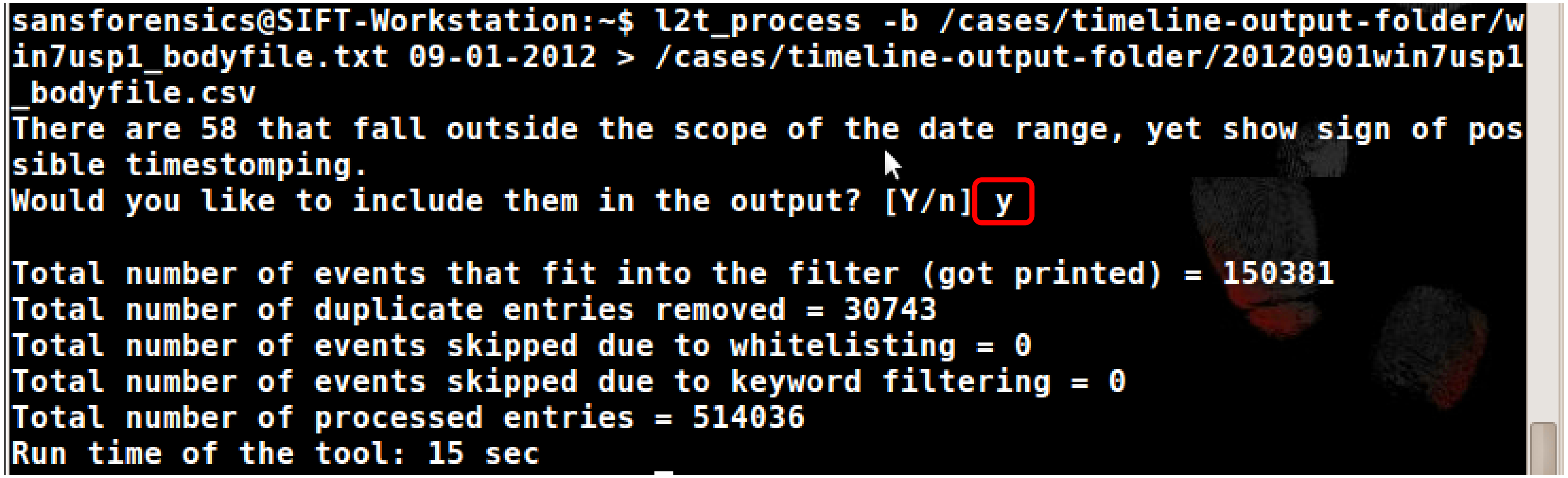

Timeline Creation(Cont.)

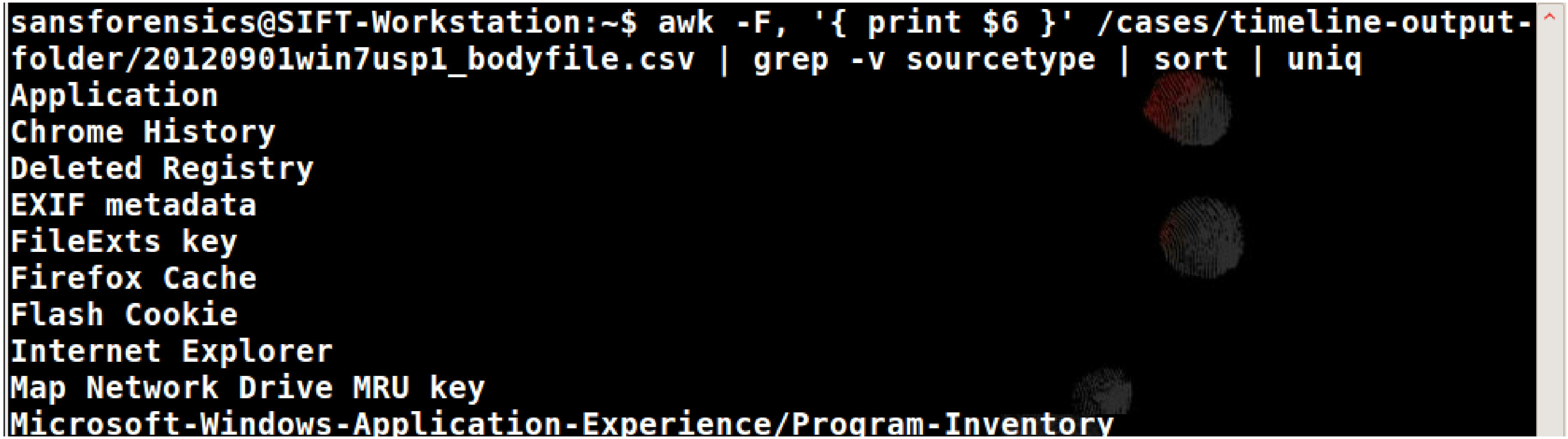
- log2timeline-sift on SANS SIFT Workstation
  - filter by date range
    - l2t_process -b /cases/timeline-output-folder/ImageFileName_bodyfile.txt StartDate (..EndDate) > path_to_output_CSV



```
sansforensics@SIFT-Workstation:~$ l2t_process -b /cases/timeline-output-folder/w
in7usp1_bodyfile.txt 09-01-2012 > /cases/timeline-output-folder/20120901win7usp1
_bodyfile.csv
There are 58 that fall outside the scope of the date range, yet show sign of pos
sible timestomping.
Would you like to include them in the output? [Y/n] y

Total number of events that fit into the filter (got printed) = 150381
Total number of duplicate entries removed = 30743
Total number of events skipped due to whitelisting = 0
Total number of events skipped due to keyword filtering = 0
Total number of processed entries = 514036
Run time of the tool: 15 sec
```

Timeline Creation(Cont.)

- log2timeline-sift on SANS SIFT Workstation
  - Check source types of entries extracted from CSV
    - awk -F, ‘{print $6;}’ path_to_the_csv_file | grep -v sourcetype | sort | uniq
  - v2.13 drops event log entries!
    - due to Japanese OS image?



```
sansforensics@SIFT-Workstation:~$ awk -F, '{ print $6 }' /cases/timeline-output-
folder/20120901win7usp1_bodyfile.csv | grep -v sourcetype | sort | uniq
Application
Chrome History
Deleted Registry
EXIF metadata
FileExts key
Firefox Cache
Flash Cookie
Internet Explorer
Map Network Drive MRU key
Microsoft-Windows-Application-Experience/Program-Inventory
```

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Checking automatic start-up programs

- malware adds its automatic start-up setting in order to run after reboot or logon
  - Checking the configurations is one of the most effective methods to detect malware
- AutoRuns
  - Display all-in output of startup settings
    - e.g., registry Run keys, services, BHOs, etc..
  - Not only live systems, but offline system volumes can be examined
    - Use “Analyze Offline System” function
- FTK Imager
  - Mount disk images with read-only

Hands-on#1: Checking automatic start-up programs

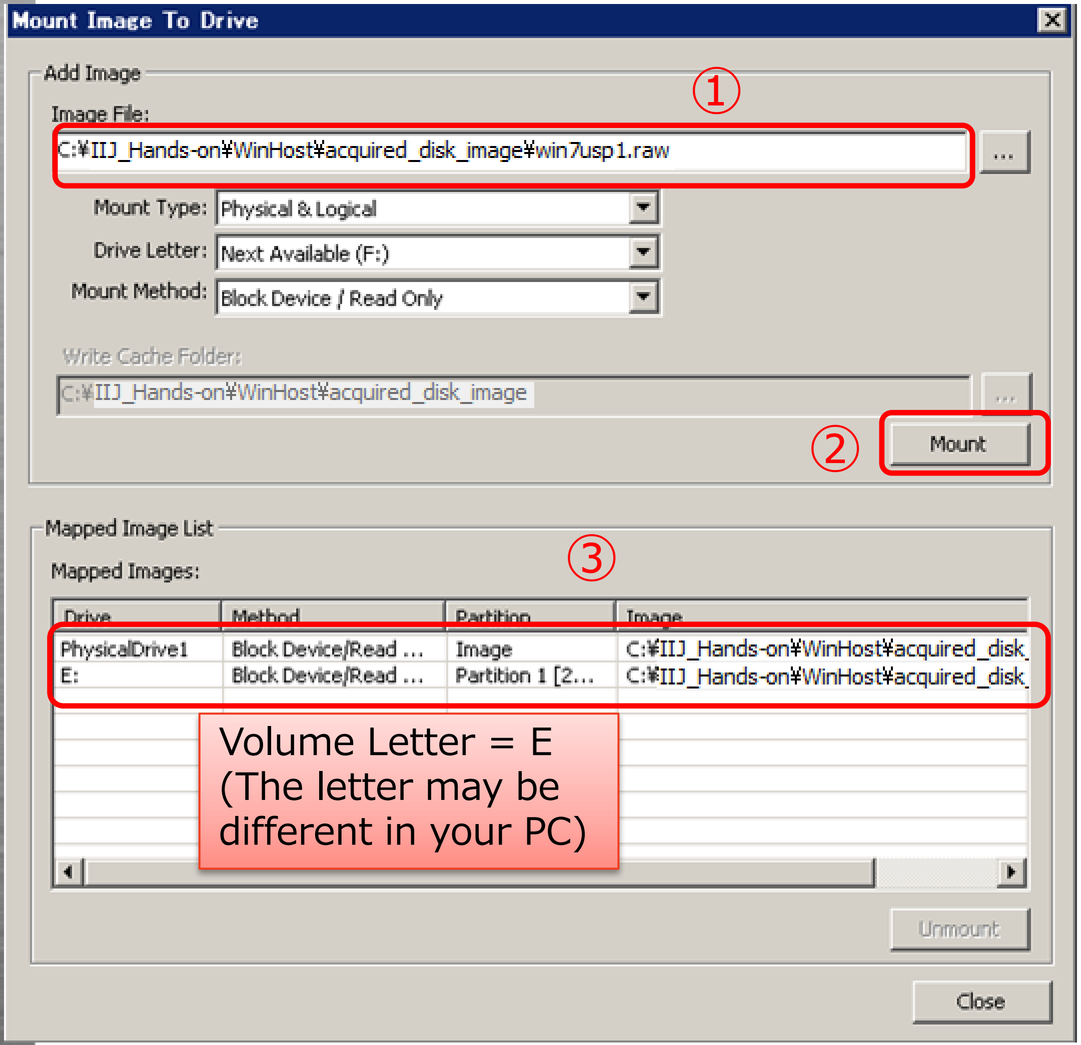


Image File: C:¥IIJ_Hands-on¥WinHost¥acquired_disk_image¥win7usp1.raw

Mount Type: Physical & Logical

Drive Letter: Next Available (F:)

Mount Method: Block Device / Read Only

Write Cache Folder: C:¥IIJ_Hands-on¥WinHost¥acquired_disk_image

Mapped Images:

Drive	Method	Partition	Image
PhysicalDrive1	Block Device/Read ...	Image	C:¥IIJ_Hands-on¥WinHost¥acquired_disk_
E:	Block Device/Read ...	Partition 1 [2...	C:¥IIJ_Hands-on¥WinHost¥acquired_disk_

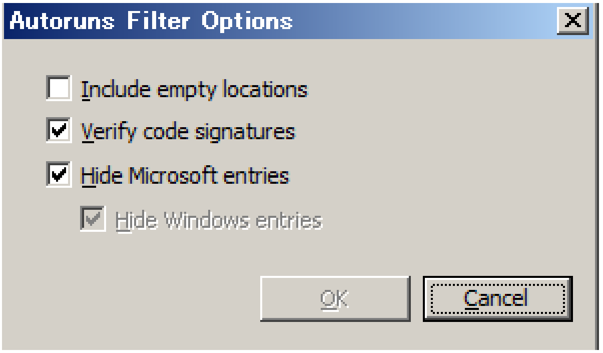
Volume Letter = E
(The letter may be different in your PC)

- FTK Imager
  - Install
    - C:¥IIJ_Hands-on¥WinHost¥tools¥AccessData%20FTK%20Imager.exe
  - [File] -> [Image Mounting...]
    1. Specify the image file path
    2. Mount
    3. Check Mapped Images
       - What’s the drive letter?

hands-on
Host OS

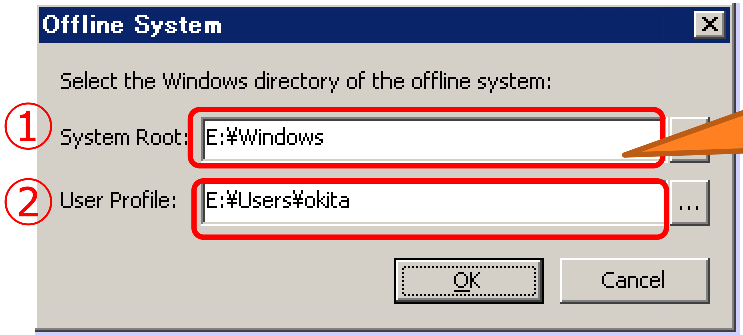
Hands-on#1: Checking automatic start-up programs (Cont.)

- AutoRuns
  - Extract "C:¥IIJ_Hands-on¥WinHost¥tools¥Autoruns.zip“
  - Run autoruns.exe **as administrator**
    - Check the window name (admin user name is displayed?)
  - Select [Options] -> [Filter Options] to reduce some noise
  - [File] -> [Analyze Offline System…]
    1. System Root = Mounted_Image_Volume_Letter:¥Windows
    2. User Profile = Mounted_Image_Volume_Letter:¥Users¥okita



Autoruns Filter Options

☐ Include empty locations
☑ Verify code signatures
☑ Hide Microsoft entries
☑ Hide Windows entries



Offline System

Select the Windows directory of the offline system:

① System Root: E:¥Windows

② User Profile: E:¥Users¥okita

Check your volume letter in FTK Imager

hands-on
Host OS

Hands-on#1: Checking automatic start-up programs (Cont.)

- Question
  - Can you find the entry of a suspicious executable file in the result of AutoRuns?
    - the registry path and file path
    - why suspicious?
- Hints
  - The system is Windows 7 SP1, UAC enabled
    - Focus on user settings (e.g., HKCU) first
  - Most Microsoft binaries are not signature-verified unless the offline OS version is identical with your live OS version
    - Skip the Microsoft entries for now

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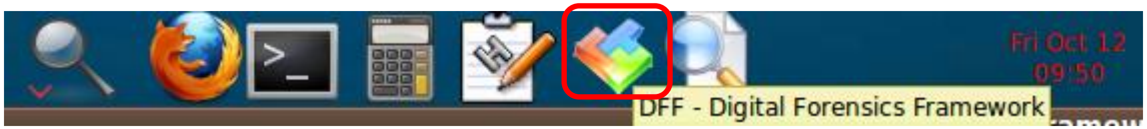
Identifying Malware Installation Time

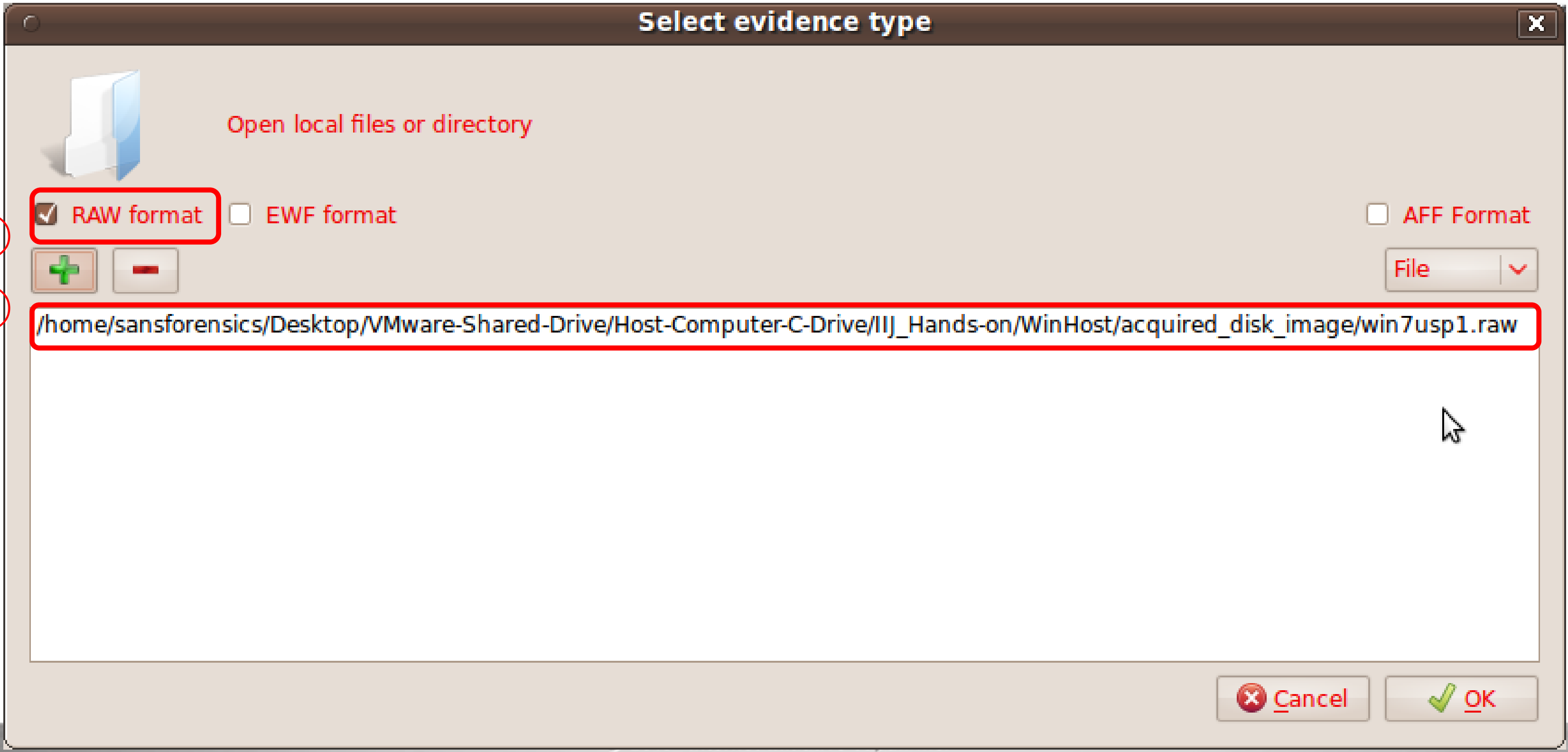
- We found suspicious registry entries
- Registry keys include last written timestamps
  - For root cause of malware infection, we can trace back timeline based on the timestamps
- Registry File Extraction
  - Digital Forensic Framework
    - Parse disk images, then browse/display file content including deleted/unallocated space
- Registry Analysis
  - Registry Decoder
    - Parse registry files, then brose/search the keys/values/data

Hands-on 2

Registry File Extraction

- Digital Forensic Framework on SIFT
  - Click DFF icon on SIFT menu bar
  - [File] -> [Open evidence file(s)]
  - Specify ①RAW format, ②image file path





Select evidence type

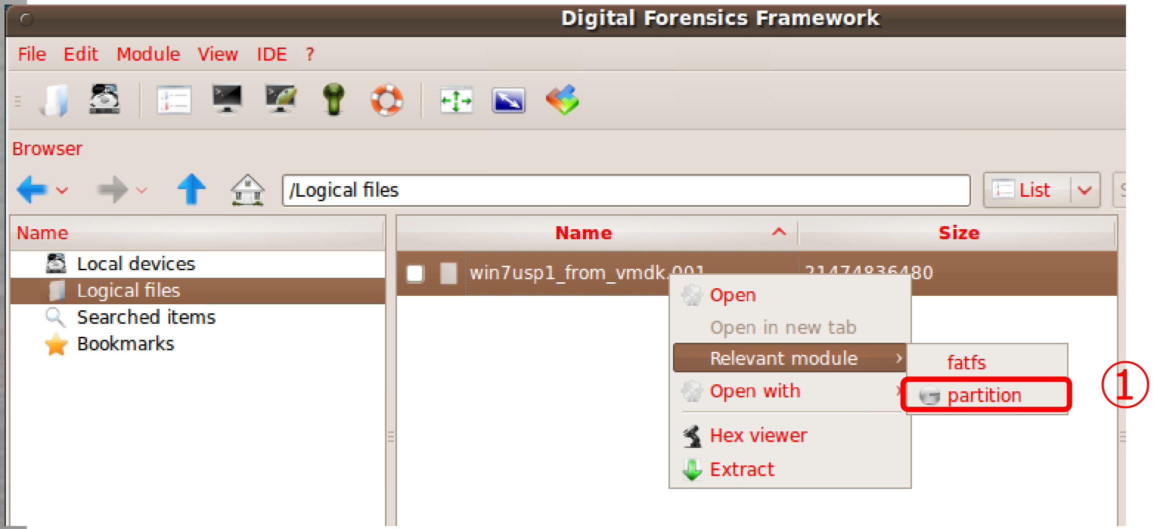
Open local files or directory

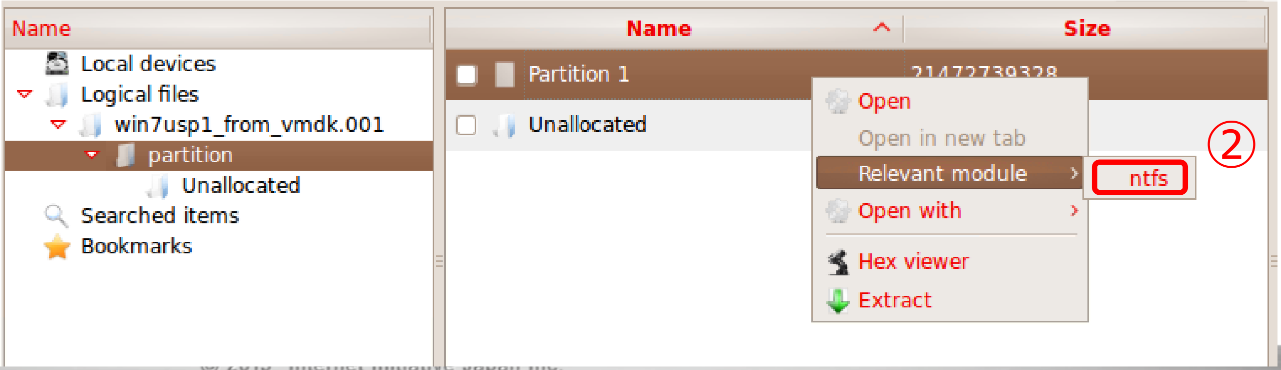
① ☑ RAW format ☐ EWF format ☐ AFF Format

② /home/sansforensics/Desktop/VMware-Shared-Drive/Host-Computer-C-Drive/IIJ_Hands-on/WinHost/acquired_disk_image/win7usp1.raw

Registry File Extraction (Cont.)

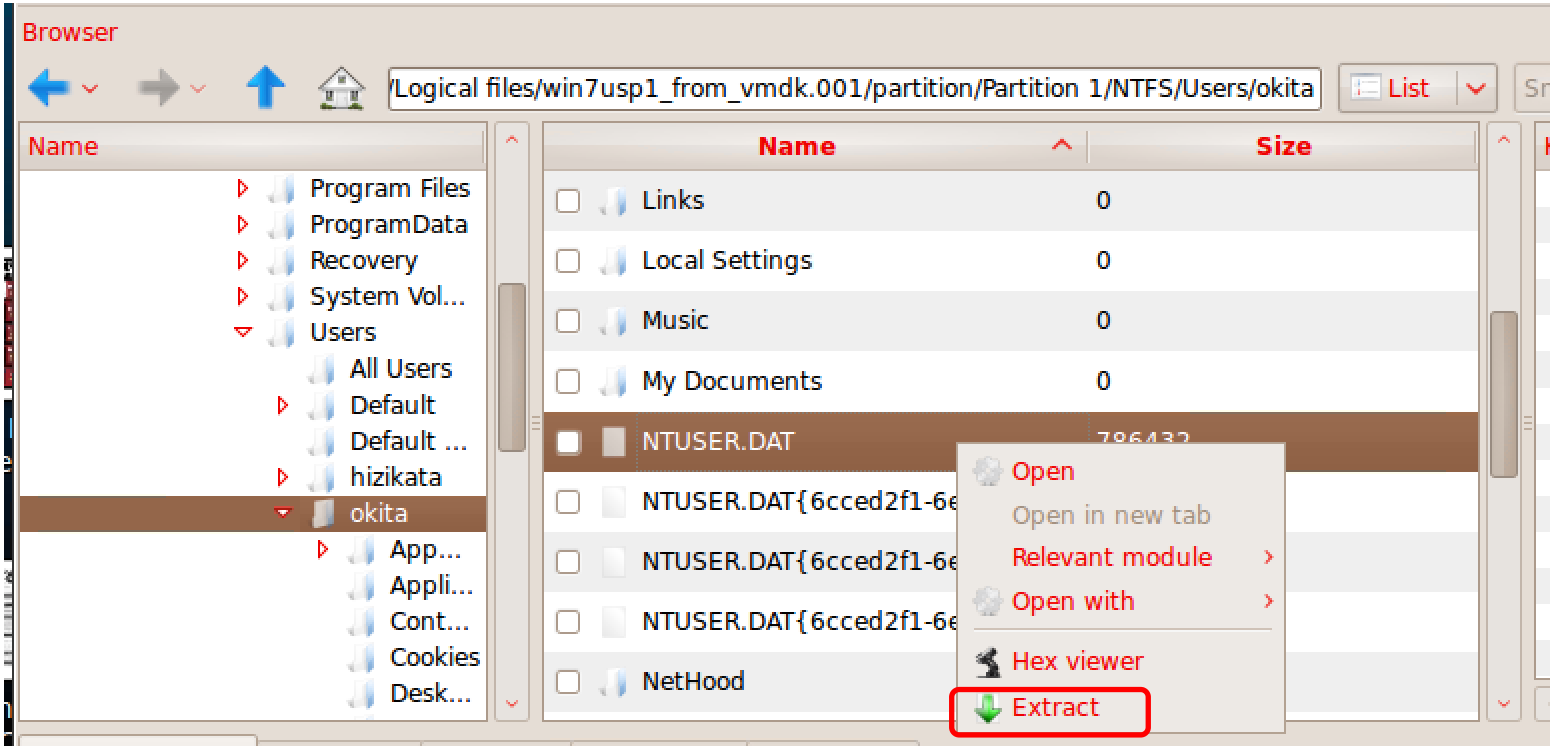
- Digital Forensic Framework on SIFT
  - Parse NTFS filesystem using “Relevant module”
    - [Relevant module] -> ①partition, ②ntfs





Registry File Extraction (Cont.)

- Digital Forensic Framework on SIFT
  - Extract the registry file
    - Save it to Host OS's folder



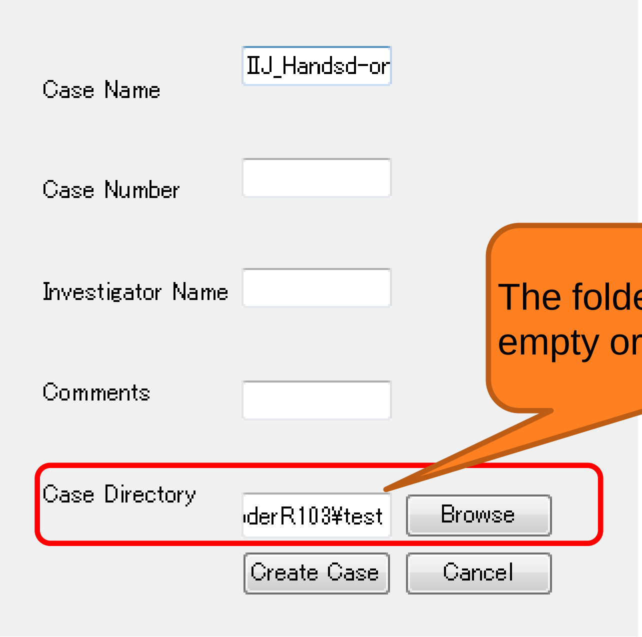
Name	Size
Links	0
Local Settings	0
Music	0
My Documents	0
NTUSER.DAT	786432
NTUSER.DAT{6cced2f1-6e	
NTUSER.DAT{6cced2f1-6e	
NTUSER.DAT{6cced2f1-6e	
NetHood	

Hands-on#2: Registry Analysis

hands-on
Host OS

- Registry Decoder
  - Extract "C:¥IIJ_Hands-on¥WinHost¥tools¥regedcoderR103.zip“
  - Run regdecoderR103.exe
    - Select [Start a new case] and Next
    - Create Case
      - Case Directory="C:¥IIJ_Hands-on¥WinHost¥tools¥regedcoderR103¥test” should be newly-created!!
    - Add Evidence
      - C:¥IIJ_Hands-on¥WinHost¥exported_registry_files¥okita¥NTUSER.DAT

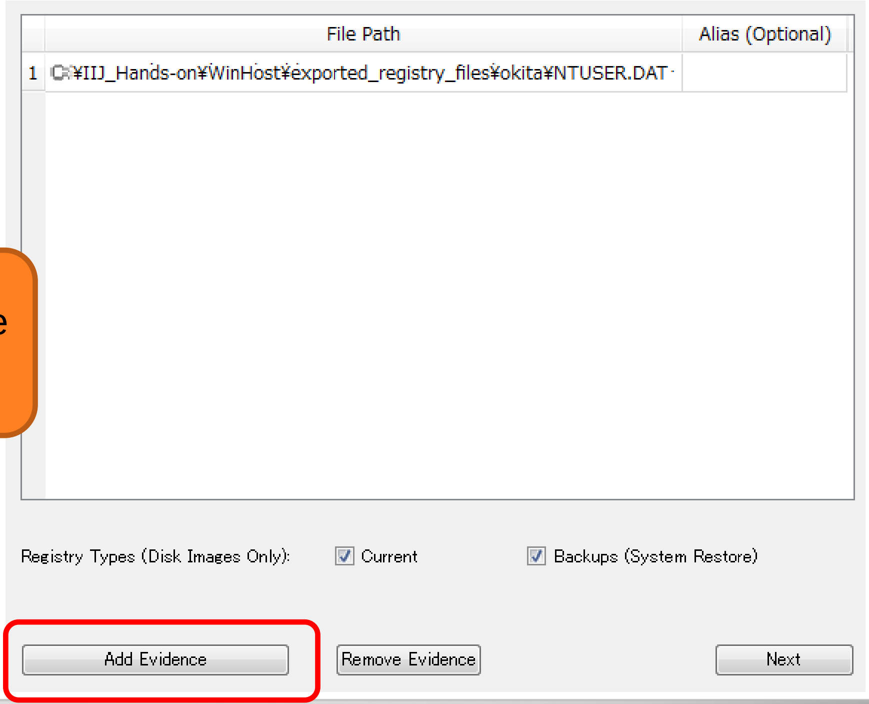
Create Case



Case Name	IIJ_Handsd-or
Case Number	
Investigator Name	
Comments	
Case Directory	derR103¥test

The folder should be empty or crash!!

Add Evidence



	File Path	Alias (Optional)
1	C:¥IIJ_Hands-on¥WinHost¥exported_registry_files¥okita¥NTUSER.DAT	

Registry Types (Disk Images Only): ☑ Current ☑ Backups (System Restore)

Hands-on#2: Registry Analysis

hands-on
Host OS

- Question
  - Check the last written time of the registry key including the suspicious registry values
  - How?

Hands-on#2: Registry Analysis

hands-on
Host OS

- Hints
  - Use Registry Decoder's Browse function
    1. Select [File View] tab, then click [View]
    2. Select opened [Browse] tab, then check the Run key
  - Use Registry Decoder's Search Function
    1. Select the registry file in [Search] tab
    2. Input search keyword in [Search Term] text area
       - You should extract the keyword from exe file path
    3. Select [Partial Search] if needed
    4. Check all kinds of search targets
       - Keys, Names, Data

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Timeline Analysis

- Approach to root cause of malware infection
  - Check various timestamps of the suspicious binary for validation

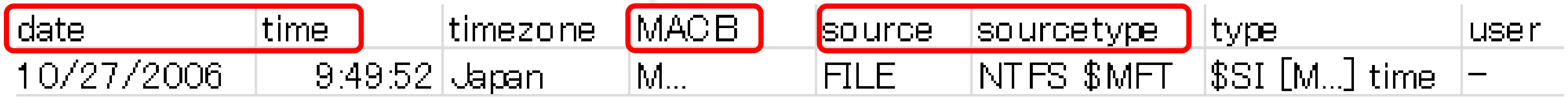
	Registry key	File System	Prefetch	ShimCache
Description	last written time	MACB times	first & last run time	file modification time
Tool	log2timeline, Registry Decoder	log2timeline	Windows Prefetch Parser	ShimCache Parser
Risk	overwritten by another values	modified by malware	SSD image	? (shutdown needed)
Result YYYY/MM/DD HH:MM:SS	2012/10/5 18:48:30	2012/10/5 17:05:56	not found	2012/10/5 17:05:56

Hands-on#3: Timeline Analysis

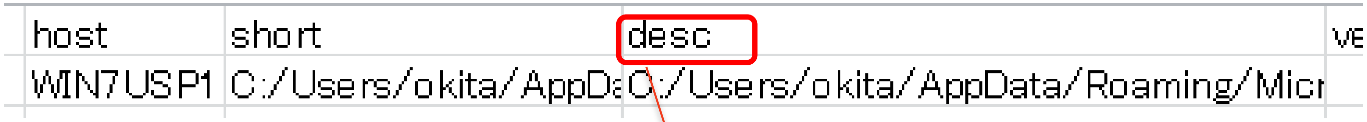
- Check timeline generated by log2timeline-sift
  - Extract “C:¥IIJ_Hands-on¥WinHost¥timeline¥win7usp1-current¥20120901-win7usp1-bodyfile.zip”
  - Open the CSV file with Excel or OpenOffice

Focus on
A, B, D, E, F, K columns

modification/last access/entry modified/creation



date	time	timezone	MACB	source	sourcetype	type	user
10/27/2006	9:49:52	Japan	M...	FILE	NTFS $MFT	$SI [M...] time	-



host	short	desc	ve
WIN7USP1	C:/Users/okita/AppDa	C:/Users/okita/AppData/Roaming/Micr	

If deleted, “(deleted)” is added

hands-on
Host OS

Hands-on#3: Timeline Analysis (Cont.)

- Question
  - Are there any activities before the malware creation timestamp?
    - Related to the infection, what files were accessed/opened/created?
      - What was the user doing at that time?
- Hints
  - We have two timestamps
    - File System/ShimCache
      - 2012/10/5 17:05:56
    - Registry Key
      - 2012/10/5 18:48:30
  - In this hands-on, trace back timeline from the earlier timestamp only
    - In real case, we should check both of them
  - Check the activities for several minutes from the timestamp

Other Evidences of User Activities

- GUI programs executed by the user
  - UserAssist key in NTUSER.DAT
    - number of runs, last run timestamp
  - Registry Decoder’s User Assist plugin
- Opened files
  - Recently used Office files
    - C:¥Users¥<user>¥AppData¥Roaming¥Microsoft¥Office¥Recent¥
  - JumpList
    - C:¥Users¥<user>¥AppData¥Roaming¥Microsoft¥Windows¥Recent
    - JumpLister
  - NTUSER.DAT
    - Shell Bag, RecentDocs, etc..
    - Registry Decoder plugins（Search is also effective)

Analysis in the Case

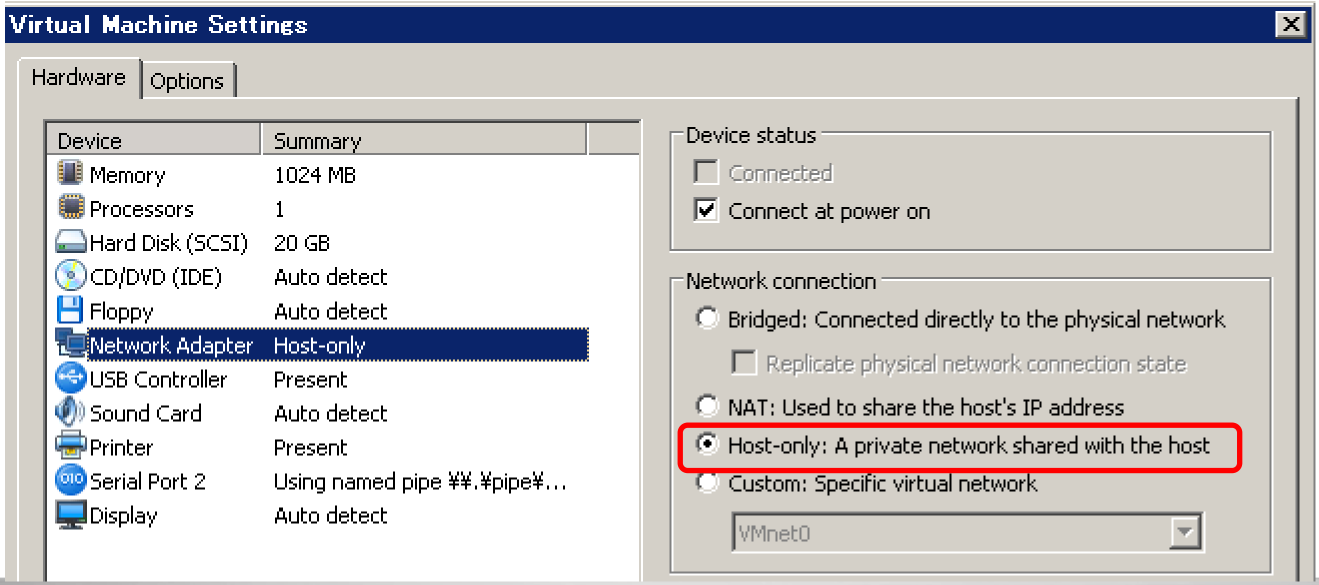
- Timeline Creation
- Root Cause Analysis of Malware Infection
  - Checking automatic start-up programs (Hands-on#1)
  - Identifying Malware Installation Time (Hands-on#2)
  - Timeline Analysis (Hands-on#3)
  - Analysis of Malicious Document File (Hands-on#4, Hands-on#5)
  - Analysis of Shellcode and Malware
  - Result
- Analysis of Post-infection Activities (Bonus Hands-on)
  - Investigating Attacker's Activity
  - Analyzing Unknown Binary
- Wrap-up

Setting up Windows Guest VM

hands-on
Host OS

hands-on
VM

- Install VMWare Tools
- Settings for running malware
  - Change the network connection to “Host-only”
  - If you use VMWare Workstation, take a snapshot for restoration
    - [VM] -> [Snapshot] -> [Take Snapshot]
  - If you use VMWare Player, edit the .vmx file to clear changes after power off (See below)
    - C:¥IIJ_Hands-on¥WinHost¥conf¥VMWare¥Player_Win_setting_En.txt
- Power-on & logon
- Create “C:¥MalwareAnalysis” folder on Windows VM, and drag and drop "C:¥IIJ_Hands-on¥WinVM“ on host OS into that folder



Virtual Machine Settings

Hardware | Options

Device	Summary
Memory	1024 MB
Processors	1
Hard Disk (SCSI)	20 GB
CD/DVD (IDE)	Auto detect
Floppy	Auto detect
Network Adapter	Host-only
USB Controller	Present
Sound Card	Auto detect
Printer	Present
Serial Port 2	Using named pipe ¥¥.¥pipe¥...
Display	Auto detect

Device status

☐ Connected

☑ Connect at power on

Network connection

○ Bridged: Connected directly to the physical network

☐ Replicate physical network connection state

○ NAT: Used to share the host's IP address

● Host-only: A private network shared with the host

○ Custom: Specific virtual network

VMnet0

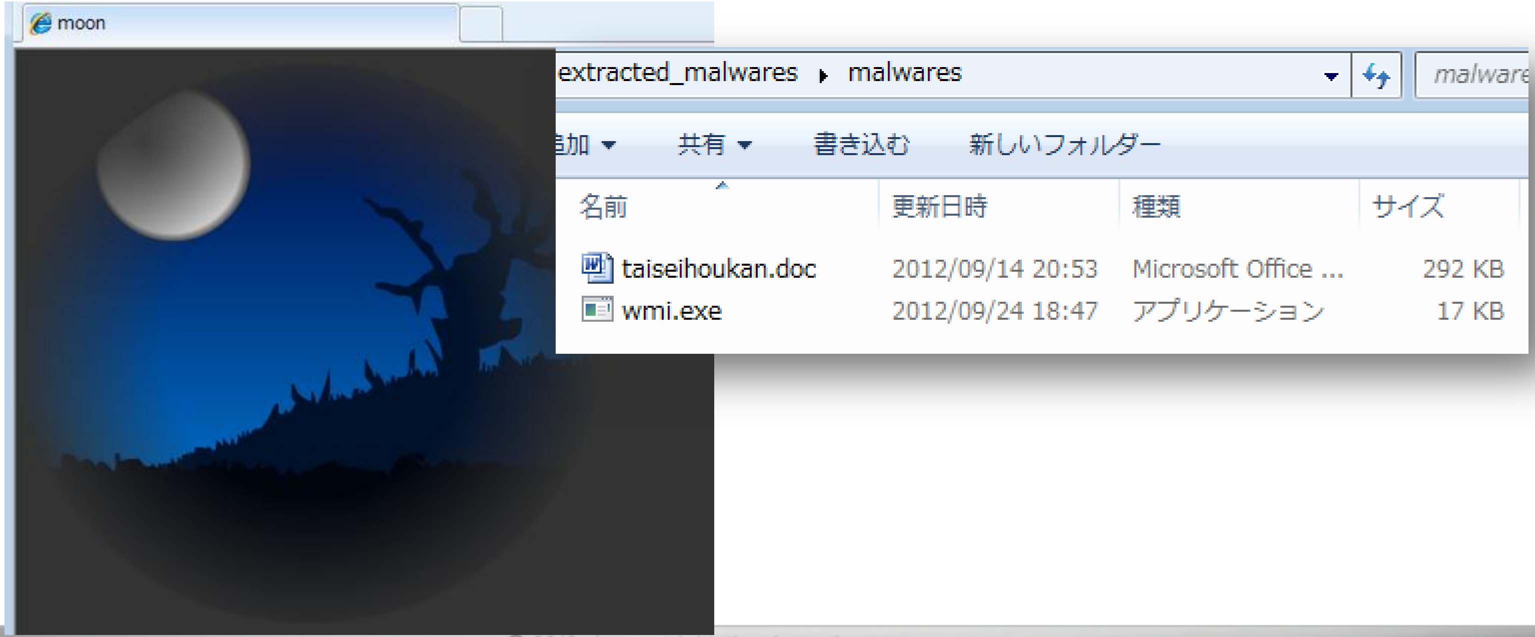
Dynamic Analysis of Malicious Document File

- Dynamic Analysis
  - Monitor RAM/disk/network activities after opening the doc file “taiseihoukan.doc” on Windows VM
    - Monitor process/filesystem/registry/network
      - Process Hacker/Process Explorer
      - CaptureBAT
    - Emulate fake server
      - FakeNet

hands-on VM

Hands-on#4: Dynamic Analysis of Malicious Document File

- Set up for dynamic analysis
  - Install Adobe Flash Player ActiveX
    - "C:¥MalwareAnalysis¥WinVM¥tools¥flashplayer11_2r202_233_winax_32bit.exe"
  - Access to a Flash test page using Internet Explorer
    - "C:¥MalwareAnalysis¥WinVM¥tools¥flash_IE_test_page¥moon.html“
  - Extract the malware from zip file (Password: “infected”)
    - C:¥MalwareAnalysis¥WinVM¥extracted_malwares¥malwares.zip“.



名前	更新日時	種類	サイズ
taiseihoukan.doc	2012/09/14 20:53	Microsoft Office ...	292 KB
wmi.exe	2012/09/24 18:47	アプリケーション	17 KB

hands-on VM

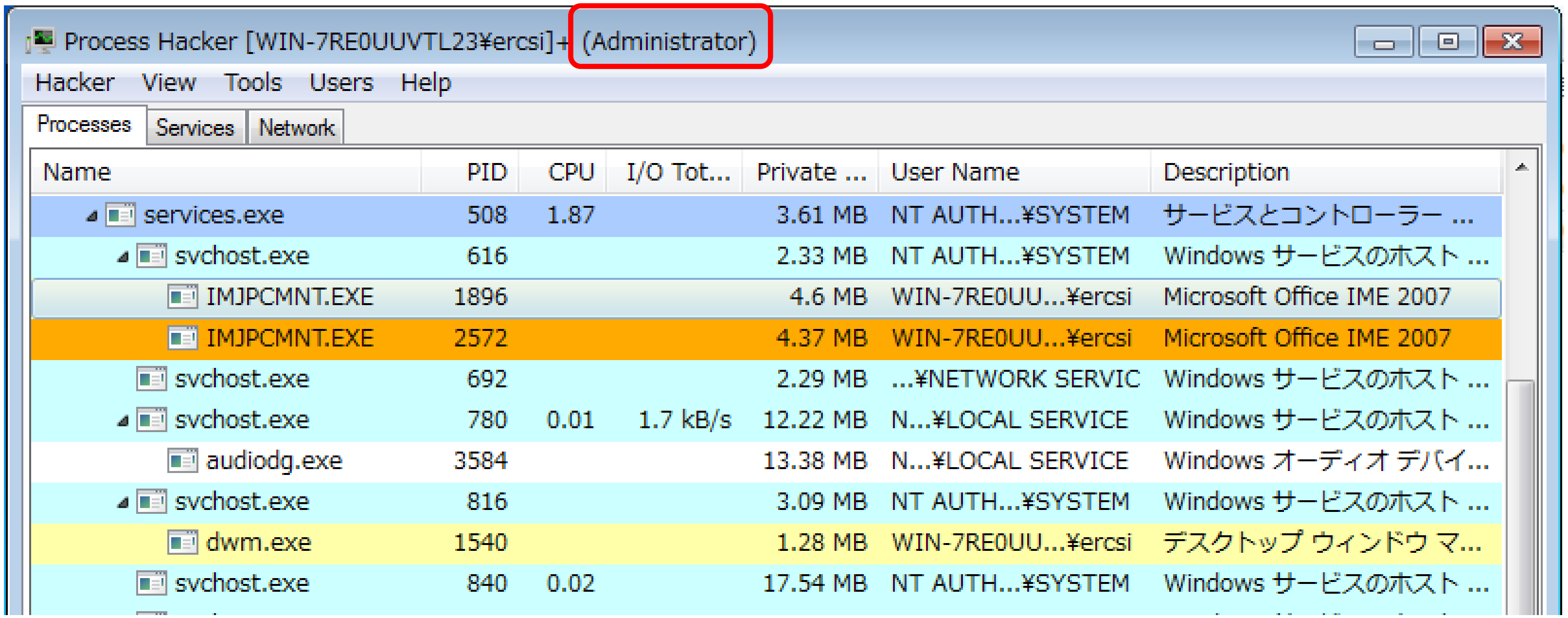
Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- Install CaptureBAT
  - Install
    - “C:¥MalwareAnalysis¥WinVM¥tools¥CaptureBAT¥CaptureBAT.exe“
  - Restart the VM

hands-on VM

Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- Process Hacker
  - Extract
    - "C:¥MalwareAnalysis¥WinVM¥tools¥processhacker-2.28-bin.zip“
  - Run **as administrator**
    - ArchName¥ProcessHacker.exe
  - Check process trees, installed services, network socket status



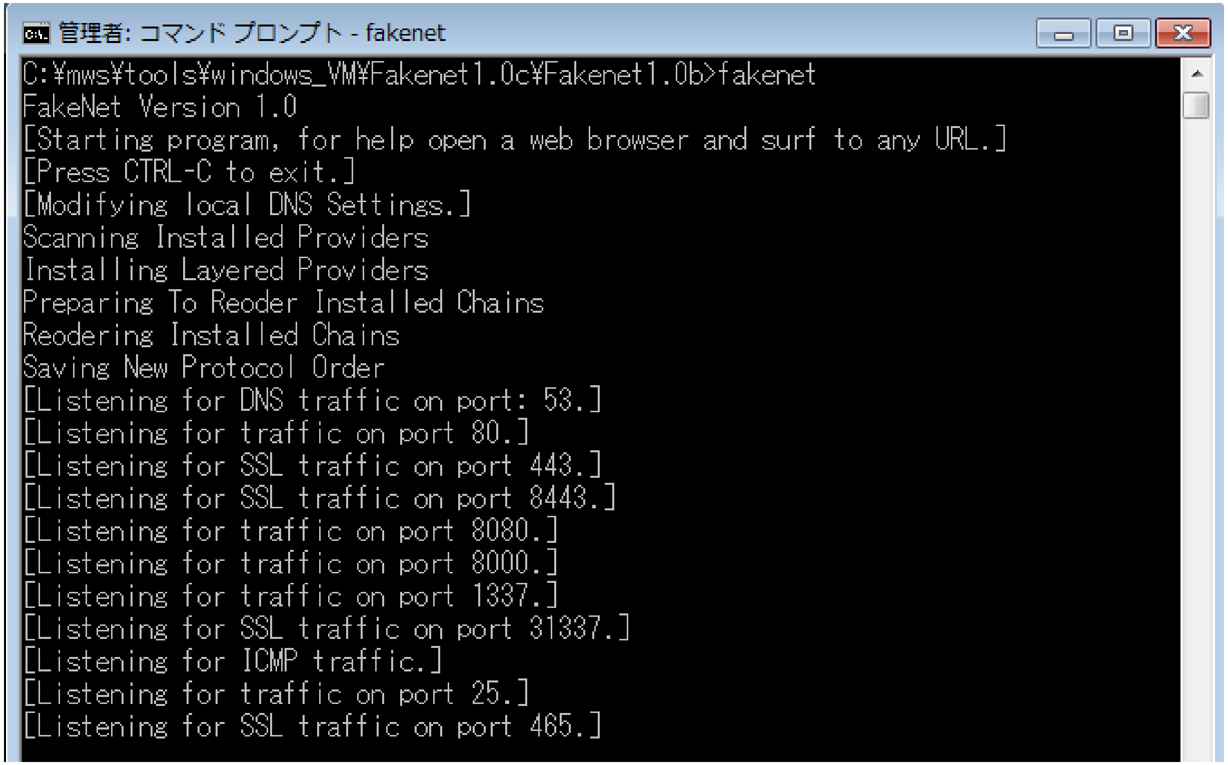
Process Hacker [WIN-7RE0UUVTL23¥ercsi]+ (Administrator)

Name	PID	CPU	I/O Tot...	Private ...	User Name	Description
services.exe	508	1.87		3.61 MB	NT AUTH...¥SYSTEM	サービスとコントローラー ...
svchost.exe	616			2.33 MB	NT AUTH...¥SYSTEM	Windows サービスのホスト ...
IMJPCMNT.EXE	1896			4.6 MB	WIN-7RE0UU...¥ercsi	Microsoft Office IME 2007
IMJPCMNT.EXE	2572			4.37 MB	WIN-7RE0UU...¥ercsi	Microsoft Office IME 2007
svchost.exe	692			2.29 MB	...¥NETWORK SERVIC	Windows サービスのホスト ...
svchost.exe	780	0.01	1.7 kB/s	12.22 MB	N...¥LOCAL SERVICE	Windows サービスのホスト ...
audiodg.exe	3584			13.38 MB	N...¥LOCAL SERVICE	Windows オーディオ デバイ...
svchost.exe	816			3.09 MB	NT AUTH...¥SYSTEM	Windows サービスのホスト ...
dwm.exe	1540			1.28 MB	WIN-7RE0UU...¥ercsi	デスクトップ ウィンドウ マ...
svchost.exe	840	0.02		17.54 MB	NT AUTH...¥SYSTEM	Windows サービスのホスト ...

hands-on VM

Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- FakeNet
  - Disable Windows Firewall
  - Extract
    - “C:¥MalwareAnalysis¥WinVM¥tools¥Fakenet1.0c.zip”
  - Run **as administrator** on cmd.exe
  - Check the configuration using nslookup command or web access

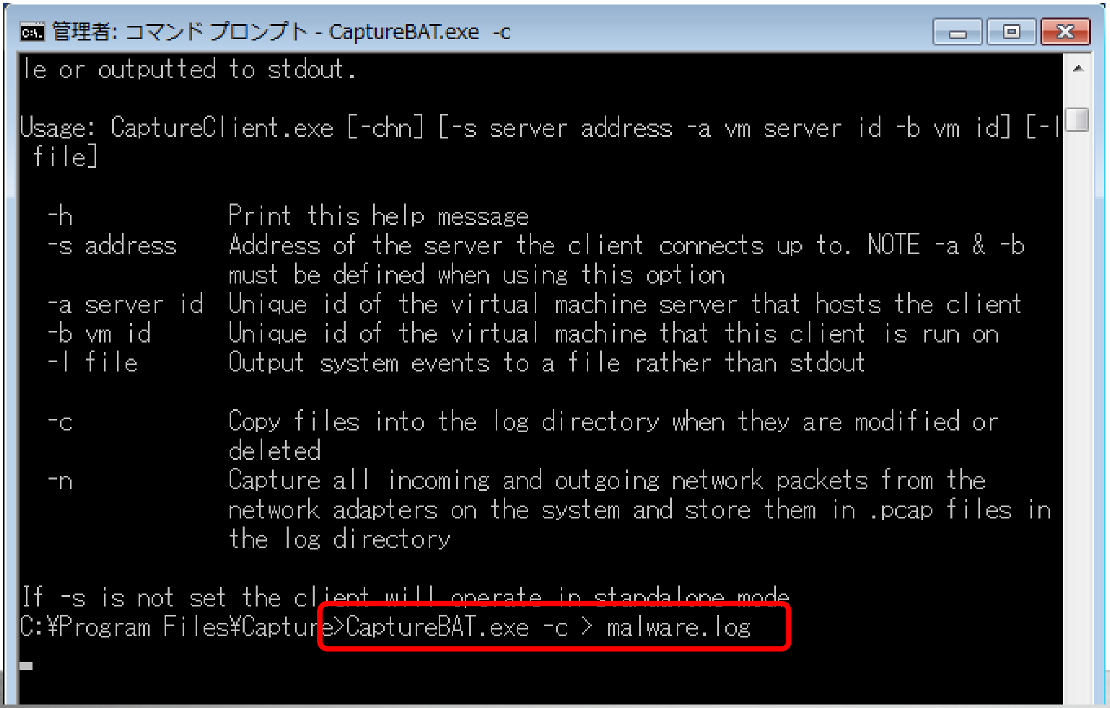


```
C:¥mws¥tools¥windows_VM¥Fakenet1.0c¥Fakenet1.0b>fakenet
FakeNet Version 1.0
[Starting program, for help open a web browser and surf to any URL.]
[Press CTRL-C to exit.]
[Modifying local DNS Settings.]
Scanning Installed Providers
Installing Layered Providers
Preparing To Reoder Installed Chains
Reodering Installed Chains
Saving New Protocol Order
[Listening for DNS traffic on port: 53.]
[Listening for traffic on port 80.]
[Listening for SSL traffic on port 443.]
[Listening for SSL traffic on port 8443.]
[Listening for traffic on port 8080.]
[Listening for traffic on port 8000.]
[Listening for traffic on port 1337.]
[Listening for SSL traffic on port 31337.]
[Listening for ICMP traffic.]
[Listening for traffic on port 25.]
[Listening for SSL traffic on port 465.]
```

hands-on VM

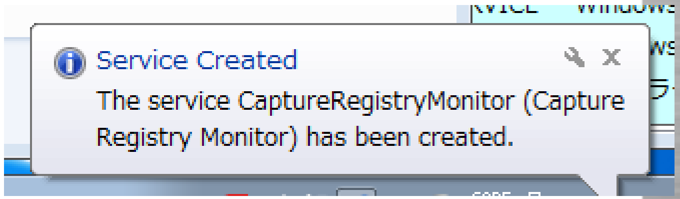
Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- Run CaptureBAT
  - After installation, the binary is located at C:¥Program Files¥Capture
  - Run **as administrator** on cmd.exe
    - Redirect the output to log file
    - -c: Capture modified and deleted files
  - After running, Check whether Process Hacker reports CaptureBAT services are created
    - If you cannot find the message, please check Services tab in Process Hacker



管理者: コマンド プロンプト - CaptureBAT.exe -c

```
le or outputted to stdout.

Usage: CaptureClient.exe [-chn] [-s server address -a vm server id -b vm id] [-l
 file]

  -h            Print this help message
  -s address    Address of the server the client connects up to. NOTE -a & -b
                must be defined when using this option
  -a server id  Unique id of the virtual machine server that hosts the client
  -b vm id      Unique id of the virtual machine that this client is run on
  -l file       Output system events to a file rather than stdout

  -c            Copy files into the log directory when they are modified or
                deleted
  -n            Capture all incoming and outgoing network packets from the
                network adapters on the system and store them in .pcap files in
                the log directory

If -s is not set the client will operate in standalone mode
C:¥Program Files¥Capture>CaptureBAT.exe -c > malware.log
_
```



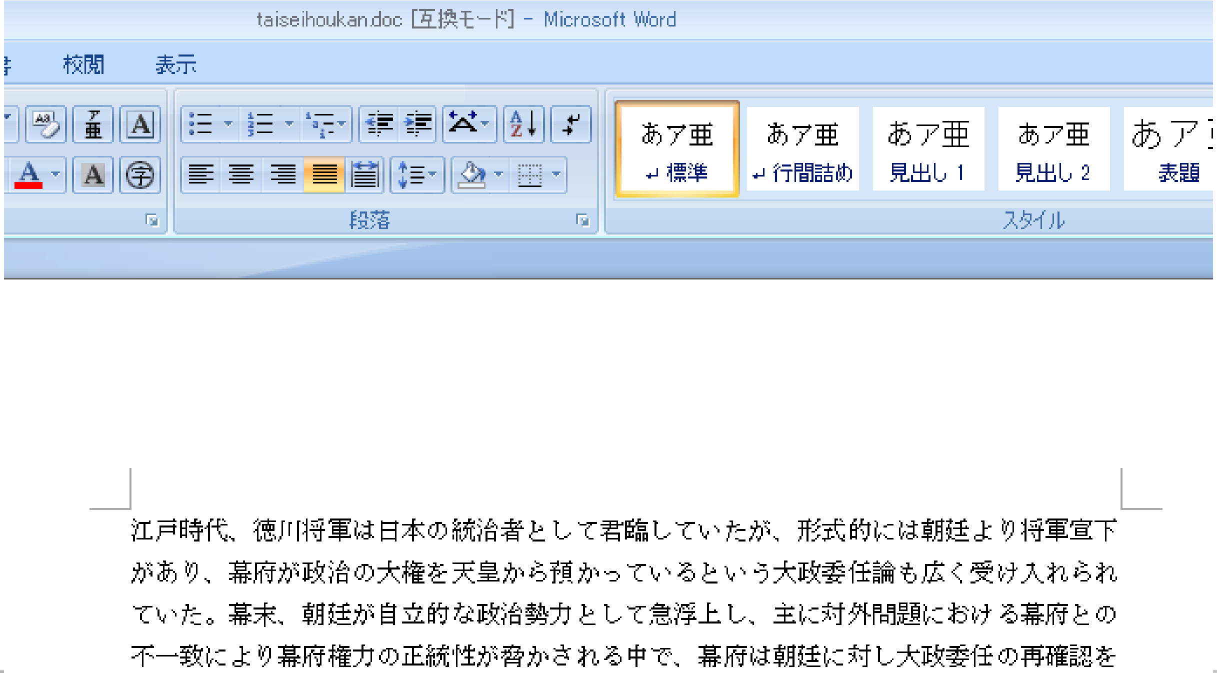
Service Created

The service CaptureRegistryMonitor (Capture Registry Monitor) has been created.

hands-on VM

Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- Open the doc file
  - taiseihoukan.doc in "C:¥MalwareAnalysis¥WinVM¥extracted_malwares¥malwares.zip“
  - Run wmi.exe if Office 2007 is not installed in your VM
    - does NOT work on Office 2003 and 2010
- If successful, a dummy document will be opened



江戸時代、徳川将軍は日本の統治者として君臨していたが、形式的には朝廷より将軍宣下があり、幕府が政治の大権を天皇から預かっているという大政委任論も広く受け入れられていた。幕末、朝廷が自立的な政治勢力として急浮上し、主に対外問題における幕府との不一致により幕府権力の正統性が脅かされる中で、幕府は朝廷に対し大政委任の再確認を

hands-on VM

Hands-on#4: Dynamic Analysis of Malicious Document File (Cont.)

- Questions
  - What's the malicious hostname and port number where the malware tries to connect?
  - Which process adds auto-start settings for the malware?
- Hint
  - Check the results
    - CaptureBAT
      - Press any key to exit
      - Search doc/exe name in the log
    - FakeNet
      - Press Ctrl-C
      - Check the console output

Analyzing Malicious Office Documents

- Checking embedded code/file
  - String search
    - Flash file signatures (“FWS”, “CWS”)
    - JavaScript (“ScriptBridge”), etc..
  - Parse OLE structure
    - FileInsight
    - Pyew/hachoir-subfile
- Scanning malicious payloads
  - OfficeMalScanner
    - Detect & extract PE/shellcode/swf

hands-on VM

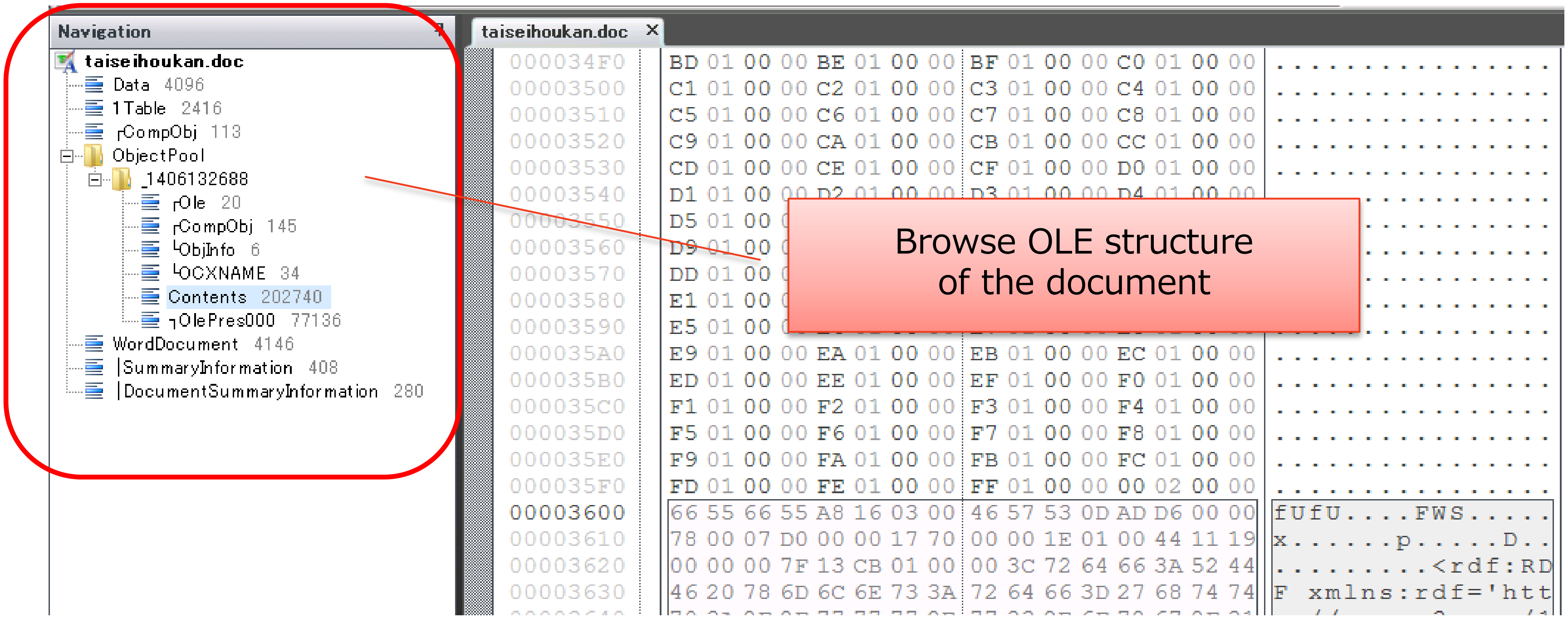
Hands-on#5: Analyzing Malicious Office Documents

- You should work in VM, not host OS (See hands-on mark)
- Question
  - Do you think what vulnerability was used for the exploitation of the PC?
    - **Guess CVE number** of this exploit.
- Hints
  - **Notice: The document seemed to include a Flash object**
  - Check & extract an embedded object in the Office document
    - FileInsight
    - OfficeMalScanner
  - Decompile the object
    - AS3 Sorcerer
    - Read the decompiled code and guess the vulnerability
    - Find characteristic strings and use search engine (e.g. Google) ;-)

hands-on
VM

Hands-on#5: Analyzing Malicious Office Documents (Cont.)

- How to use & install tools
  - FileInsight
    - Install
      - "C:¥MalwareAnalysis¥WinVM¥tools¥fileinsight.exe“ in VM
    - Run
      - Drag and Drop "taiseihoukan.doc" into FileInsight



```
Navigation
taiseihoukan.doc
  Data  4096
  1Table  2416
  ┌CompObj  113
  ObjectPool
    _1406132688
      ┌Ole  20
      ┌CompObj  145
      └ObjInfo  6
      └OCXNAME  34
      Contents  202740
      ┐OlePres000  77136
  WordDocument  4146
  |SummaryInformation  408
  |DocumentSummaryInformation  280
```

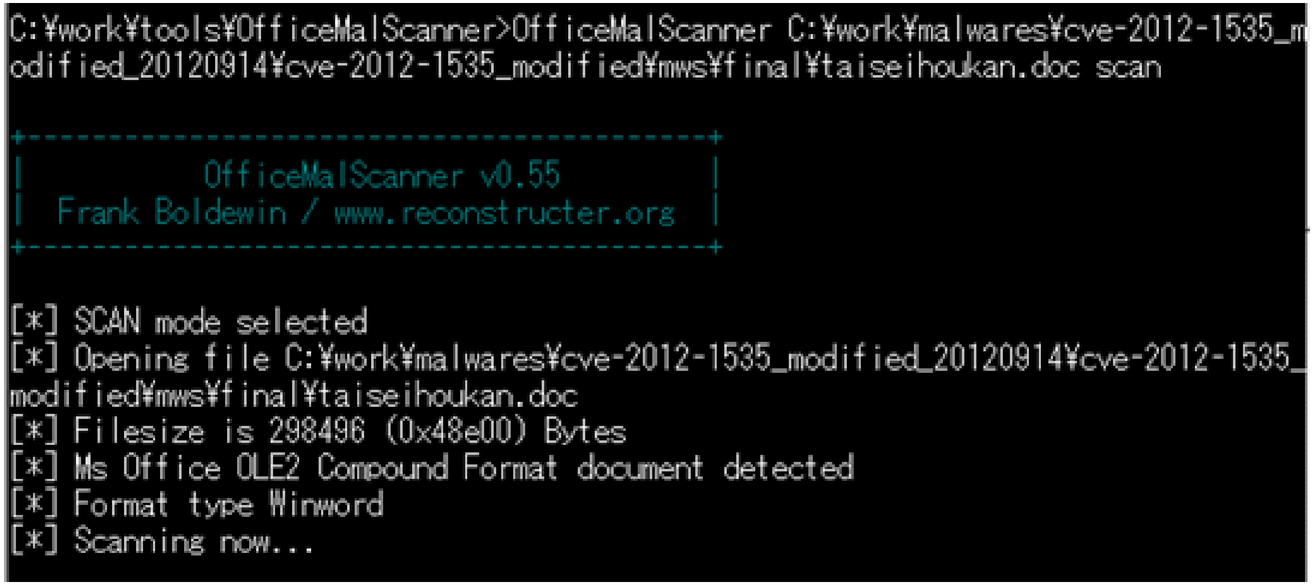
```
taiseihoukan.doc ✕
000034F0  BD 01 00 00 BE 01 00 00 BF 01 00 00 C0 01 00 00  ................
00003500  C1 01 00 00 C2 01 00 00 C3 01 00 00 C4 01 00 00  ................
00003510  C5 01 00 00 C6 01 00 00 C7 01 00 00 C8 01 00 00  ................
00003520  C9 01 00 00 CA 01 00 00 CB 01 00 00 CC 01 00 00  ................
00003530  CD 01 00 00 CE 01 00 00 CF 01 00 00 D0 01 00 00  ................
00003540  D1 01 00 00 D2 01 00 00 D3 01 00 00 D4 01 00 00  ................
00003550  D5 01 00                                          ............
00003560  D9 01 00                                          ............
00003570  DD 01 00                                          ............
00003580  E1 01 00                                          ............
00003590  E5 01 00                                          ............
000035A0  E9 01 00 00 EA 01 00 00 EB 01 00 00 EC 01 00 00  ................
000035B0  ED 01 00 00 EE 01 00 00 EF 01 00 00 F0 01 00 00  ................
000035C0  F1 01 00 00 F2 01 00 00 F3 01 00 00 F4 01 00 00  ................
000035D0  F5 01 00 00 F6 01 00 00 F7 01 00 00 F8 01 00 00  ................
000035E0  F9 01 00 00 FA 01 00 00 FB 01 00 00 FC 01 00 00  ................
000035F0  FD 01 00 00 FE 01 00 00 FF 01 00 00 00 02 00 00  ................
00003600  66 55 66 55 A8 16 03 00 46 57 53 0D AD D6 00 00  fUfU....FWS.....
00003610  78 00 07 D0 00 00 17 70 00 00 1E 01 00 44 11 19  x......p.....D..
00003620  00 00 00 7F 13 CB 01 00 00 3C 72 64 66 3A 52 44  .........<rdf:RD
00003630  46 20 78 6D 6C 6E 73 3A 72 64 66 3D 27 68 74 74  F xmlns:rdf='htt
```

Browse OLE structure of the document

hands-on VM

Hands-on#5: Analyzing Malicious Office Documents (Cont.)

- How to use & install tools
  - OfficeMalScanner
    - Extract "C:¥MalwareAnalysis¥WinVM¥tools¥OfficeMalScanner.zip"
    - Run “OfficeMalScanner.exe path_to_doc scan”
      - Search PE/shellcode patterns and extract them
      - Extract SWF file

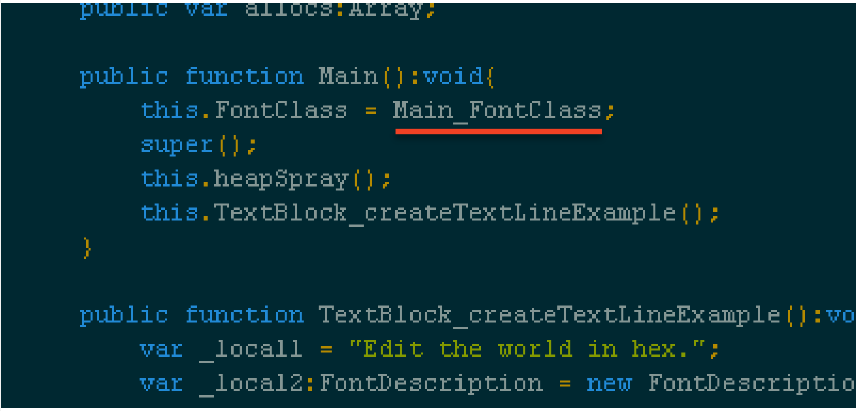


```
C:¥work¥tools¥OfficeMalScanner>OfficeMalScanner C:¥work¥malwares¥cve-2012-1535_m
odified_20120914¥cve-2012-1535_modified¥mws¥final¥taiseihoukan.doc scan

+------------------------------------------+
|           OfficeMalScanner v0.55         |
|  Frank Boldewin / www.reconstructer.org  |
+------------------------------------------+

[*] SCAN mode selected
[*] Opening file C:¥work¥malwares¥cve-2012-1535_modified_20120914¥cve-2012-1535_
modified¥mws¥final¥taiseihoukan.doc
[*] Filesize is 298496 (0x48e00) Bytes
[*] Ms Office OLE2 Compound Format document detected
[*] Format type Winword
[*] Scanning now...
```

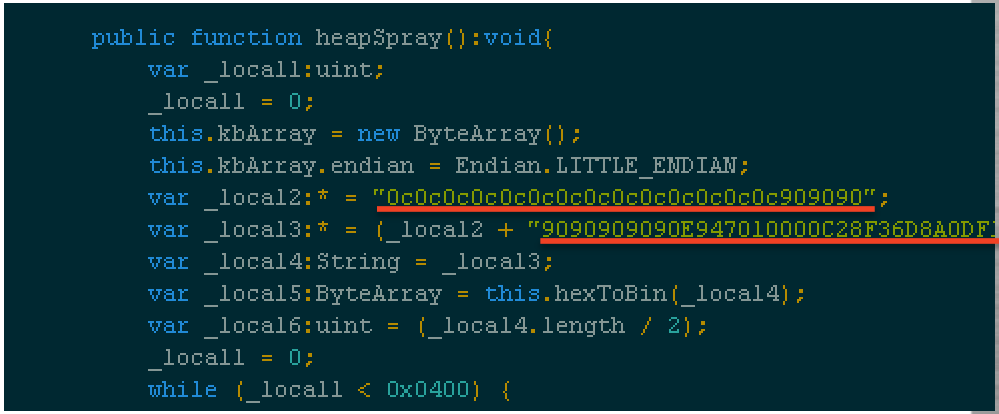
hands-on VM

Hands-on#5: Analyzing Malicious Office Documents (Cont.)

- How to use & install tools
  - AS3 Sorcerer
    - Install
      - "C:¥MalwareAnalysis¥WinVM¥tools¥as3sorcerer_setup.exe" in VM
    - Run and drag-and-drop the swf file into AS3 Sorcerer
    - Find characteristic strings and guess the vulnerability
      - Use search engine (e.g. google)



```
public var allocs:Array;

public function Main():void{
    this.FontClass = Main_FontClass;
    super();
    this.heapSpray();
    this.TextBlock_createTextLineExample();
}

public function TextBlock_createTextLineExample():vo
    var _local1 = "Edit the world in hex.";
    var _local2:FontDescription = new FontDescriptio
```



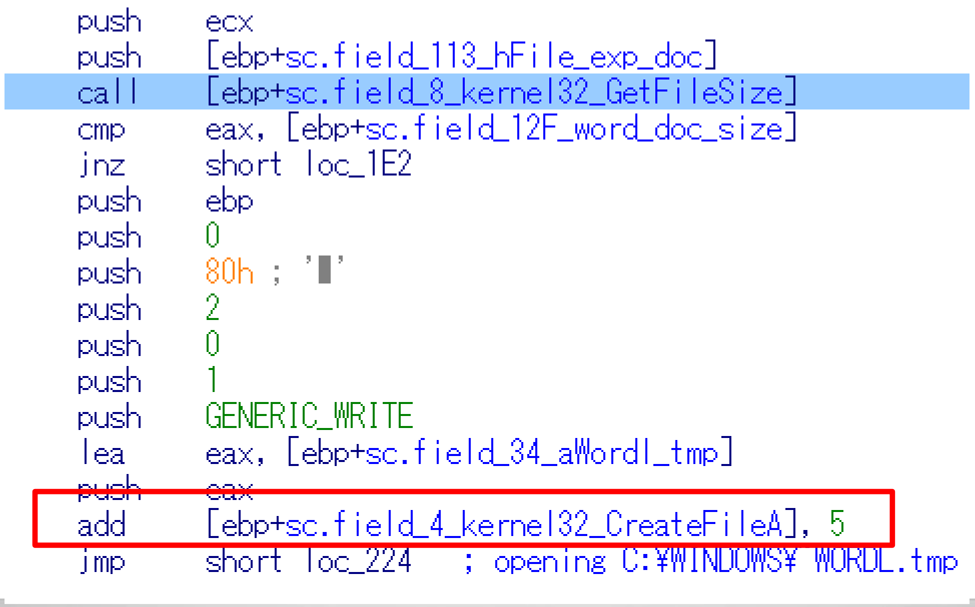
```
public function heapSpray():void{
    var _local1:uint;
    _local1 = 0;
    this.kbArray = new ByteArray();
    this.kbArray.endian = Endian.LITTLE_ENDIAN;
    var _local2:* = "0c0c0c0c0c0c0c0c0c0c0c0c909090";
    var _local3:* = (_local2 + "9090909090E947010000C28F36D8A0DF
    var _local4:String = _local3;
    var _local5:ByteArray = this.hexToBin(_local4);
    var _local6:uint = (_local4.length / 2);
    _local1 = 0;
    while (_local1 < 0x0400) {
```

Analysis in the Case

- Timeline Creation
- Root Cause Analysis of Malware Infection
  - Checking automatic start-up programs (Hands-on#1)
  - Identifying Malware Installation Time (Hands-on#2)
  - Timeline Analysis (Hands-on#3)
  - Analysis of Malicious Document File (Hands-on#4, Hands-on#5)
  - Analysis of Shellcode and Malware
  - Result
- Analysis of Post-infection Activities (Bonus Hands-on)
  - Investigating Attacker's Activity
  - Analyzing Unknown Binary
- Wrap-up

Shellcode Analysis

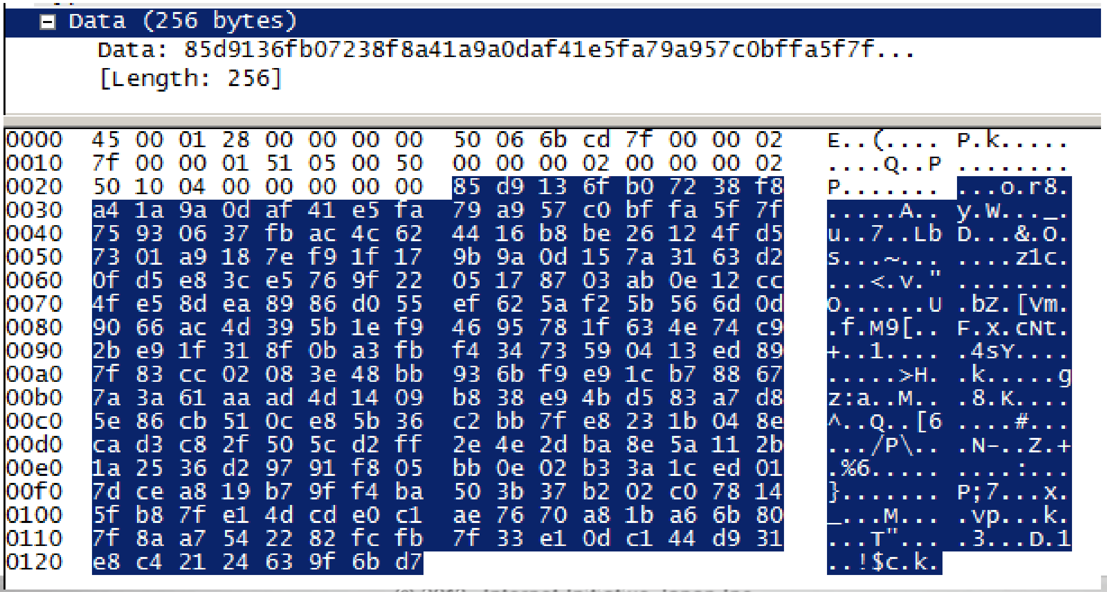
- Identification by reading decompiled code or p-code
- extraction from swf file
  - Use hex editor (e.g., FileInsight)
- emulation (checking APIs)
  - e.g., libemu
  - But, emulation doesn’t work for this shellcode...
- Debugging
  - binary paste to debuggers or use launcher program
    - http://practicalmalwareanalysis.com/labs/
- Static Analysis
  - IDA Pro



```
push    ecx
push    [ebp+sc.field_113_hFile_exp_doc]
call    [ebp+sc.field_8_kernel32_GetFileSize]
cmp     eax, [ebp+sc.field_12F_word_doc_size]
jnz     short loc_1E2
push    ebp
push    0
push    80h ; '█'
push    2
push    0
push    1
push    GENERIC_WRITE
lea     eax, [ebp+sc.field_34_aWordl_tmp]
push    eax
add     [ebp+sc.field_4_kernel32_CreateFileA], 5
jmp     short loc_224   ; opening C:¥WINDOWS¥ WORDL.tmp
```

Identifying the Malware

- Open the pcap captured by fakenet using Wireshark
  - The malware initiated communication by sending random 256 bytes on TCP port 80 of the server
  - PoisonIvy?
    - Camellia Encryption’s challenge-response negotiation
      - https://media.blackhat.com/bh-eu-10/presentations/Dereszowski/BlackHat-EU-2010-Dereszowski-Targeted-Attacks-slides.pdf
      - http://labs.alienvault.com/labs/index.php/category/blog/page/3/

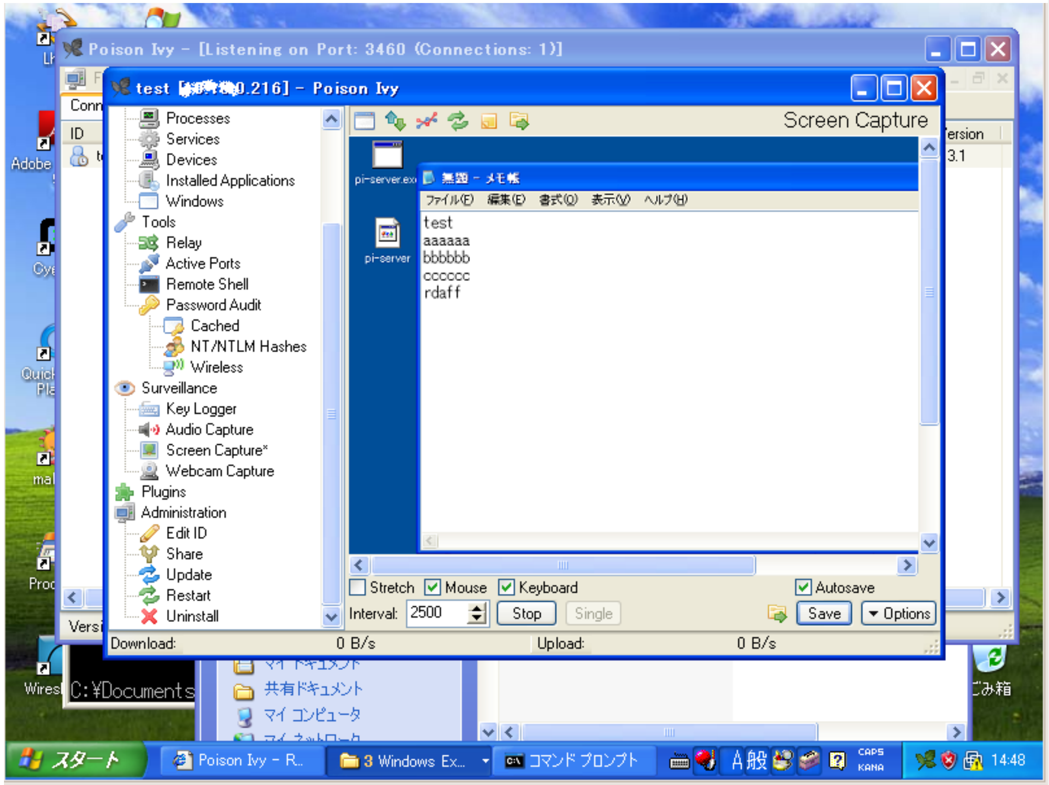


```
⊟ Data (256 bytes)
     Data: 85d9136fb07238f8a41a9a0daf41e5fa79a957c0bffa5f7f...
     [Length: 256]

0000  45 00 01 28 00 00 00 00  50 06 6b cd 7f 00 00 02   E..(.... P.k.....
0010  7f 00 00 01 51 05 00 50  00 00 00 02 00 00 00 02   ....Q..P ........
0020  50 10 04 00 00 00 00 00  85 d9 13 6f b0 72 38 f8   P....... ...o.r8.
0030  a4 1a 9a 0d af 41 e5 fa  79 a9 57 c0 bf fa 5f 7f   .....A.. y.W..._.
0040  75 93 06 37 fb ac 4c 62  44 16 b8 be 26 12 4f d5   u..7..Lb D...&.O.
0050  73 01 a9 18 7e f9 1f 17  9b 9a 0d 15 7a 31 63 d2   s...~... ....z1c.
0060  0f d5 e8 3c e5 76 9f 22  05 17 87 03 ab 0e 12 cc   ...<.v." ........
0070  4f e5 8d ea 89 86 d0 55  ef 62 5a f2 5b 56 6d 0d   O......U .bZ.[Vm.
0080  90 66 ac 4d 39 5b 1e f9  46 95 78 1f 63 4e 74 c9   .f.M9[.. F.x.cNt.
0090  2b e9 1f 31 8f 0b a3 fb  f4 34 73 59 04 13 ed 89   +..1.... .4sY....
00a0  7f 83 cc 02 08 3e 48 bb  93 6b f9 e9 1c b7 88 67   .....>H. .k.....g
00b0  7a 3a 61 aa ad 4d 14 09  b8 38 e9 4b d5 83 a7 d8   z:a..M.. .8.K....
00c0  5e 86 cb 51 0c e8 5b 36  c2 bb 7f e8 23 1b 04 8e   ^..Q..[6 ....#...
00d0  ca d3 c8 2f 50 5c d2 ff  2e 4e 2d ba 8e 5a 11 2b   .../P\.. .N-..Z.+
00e0  1a 25 36 d2 97 91 f8 05  bb 0e 02 b3 3a 1c ed 01   .%6..... ....:...
00f0  7d ce a8 19 b7 9f f4 ba  50 3b 37 b2 02 c0 78 14   }....... P;7...x.
0100  5f b8 7f e1 4d cd e0 c1  ae 76 70 a8 1b a6 6b 80   _...M... .vp...k.
0110  7f 8a a7 54 22 82 fc fb  7f 33 e1 0d c1 44 d9 31   ...T"... .3...D.1
0120  e8 c4 21 24 63 9f 6b d7                            ..!$c.k.
```

What’s Poison Ivy?

- Poison Ivy is an infamous RAT(Remote Administration Tool)
- Everyone can download the latest version at a certain web site

・execute arbitrary code
・keylogging
・hijacking mouse/keyboard
・stealing data MIC/WebCam
・file download/upload
and so on …



Poison Ivy - [Listening on Port: 3460 (Connections: 1)]

test [[redacted]0.216] - Poison Ivy

test
aaaaaa
bbbbbb
cccccc
rdaff

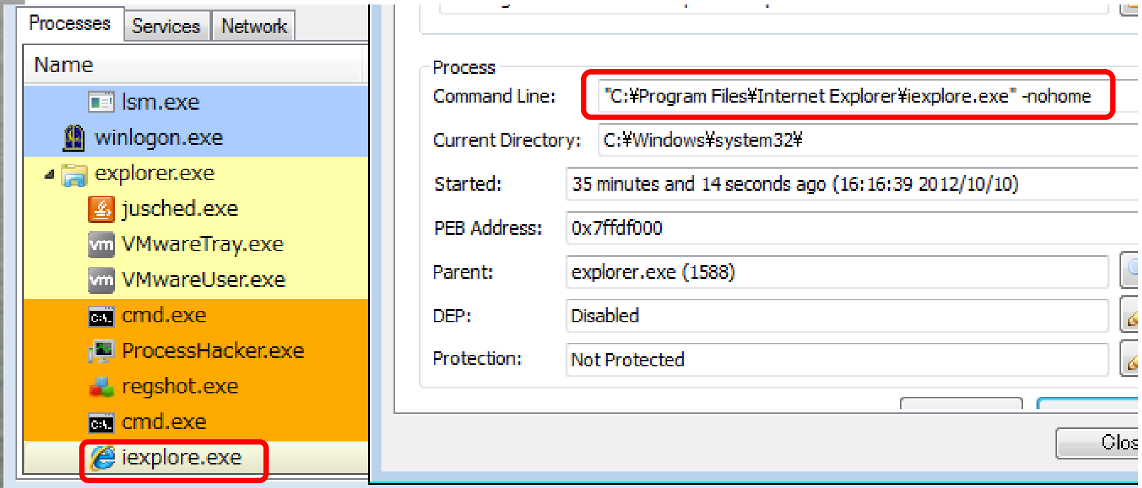
☐ Stretch ☑ Mouse ☑ Keyboard ☑ Autosave

Interval: 2500

Download: 0 B/s Upload: 0 B/s

Other Traits of Poison Ivy

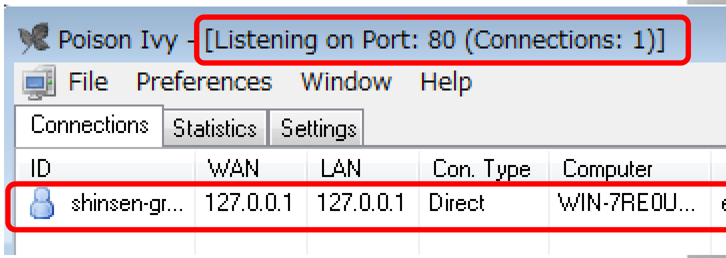
- Hidden iexplore.exe
- PoisonIvy GUI client in VM can be connected from the malware
  - Because Fakenet redirect the connection to localhost
  - The password is default ;-)
- Quick Analysis using Memory Forensics
  - Redline’s Malware Risk Index (handle name: !VoqA.I4)
  - Code injection activities



Name
- lsm.exe
- winlogon.exe
- explorer.exe
  - jusched.exe
  - VMwareTray.exe
  - VMwareUser.exe
  - cmd.exe
  - ProcessHacker.exe
  - regshot.exe
  - cmd.exe
  - iexplore.exe

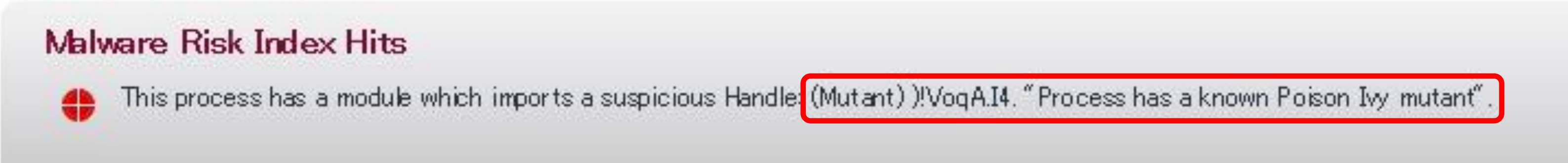
Process

Command Line:	"C:¥Program Files¥Internet Explorer¥iexplore.exe" -nohome
Current Directory:	C:¥Windows¥system32¥
Started:	35 minutes and 14 seconds ago (16:16:39 2012/10/10)
PEB Address:	0x7ffdf000
Parent:	explorer.exe (1588)
DEP:	Disabled
Protection:	Not Protected



Poison Ivy - [Listening on Port: 80 (Connections: 1)]

ID	WAN	LAN	Con. Type	Computer
shinsen-gr...	127.0.0.1	127.0.0.1	Direct	WIN-7RE0U...

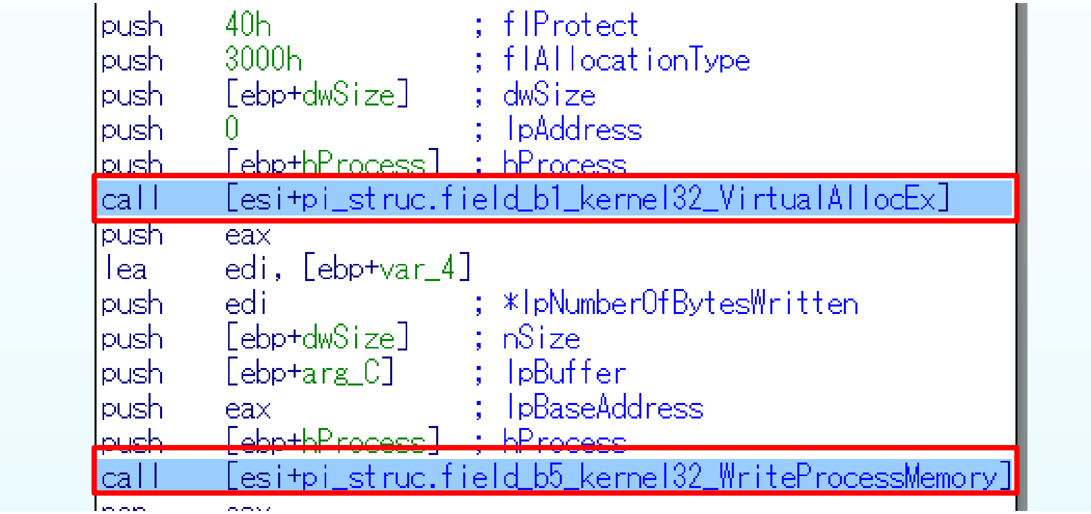


Malware Risk Index Hits

This process has a module which imports a suspicious Handle: (Mutant))!VoqA.I4. “Process has a known Poison Ivy mutant”.

Analyzing Poison Ivy

- Unpacking
  - Break VirtualAllocEx/VirtualProtectEx and extract the unpacked PE
- Debugging
  - Fragmented code injections
    - wmi.exe
      - inject code to explorer.exe
    - explorer.exe
      - install wmi.exe, create iexplore.exe process and inject code to it
    - iexplore.exe
      - connect to Poison Ivy GUI client
- Static Analysis
  - shellcode-like API resolution
  - position-independent code (e.g., call [esi + *])



```
push    40h                 ; flProtect
push    3000h               ; flAllocationType
push    [ebp+dwSize]        ; dwSize
push    0                   ; lpAddress
push    [ebp+hProcess]      ; hProcess
call    [esi+pi_struc.field_b1_kernel32_VirtualAllocEx]
push    eax
lea     edi, [ebp+var_4]
push    edi                 ; *lpNumberOfBytesWritten
push    [ebp+dwSize]        ; nSize
push    [ebp+arg_C]         ; lpBuffer
push    eax                 ; lpBaseAddress
push    [ebp+hProcess]      ; hProcess
call    [esi+pi_struc.field_b5_kernel32_WriteProcessMemory]
```

Analysis in the Case

- Timeline Creation
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  - Analysis of Malicious Document File (Hands-on#4, Hands-on#5)
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Result about Root Cause Analysis of Malware Infection

See the answer slide

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hands-on
Host OS

Bonus Hands-on: Tracking Attacker's Activities

- Question1
  - Examine post-infection activities
    - Is there any tool or exploit used by the attacker?
    - When was the tool downloaded?

hands-on
Host OS

Bonus Hands-on: Tracking Attacker’s Activities (Cont.)

- Hints for Question1
  - Imagine Attacker’s Activities from evidences that have been achieved thus far
    - a.7z
      - Domain Controller password hash database (ntds.dit) was included
        - It means DC was compromised ☹
    - Event logs
      - Different person account was authenticated on Client A
        - The acquired password hash may be used
    - What kind of tools did he use for these operations?

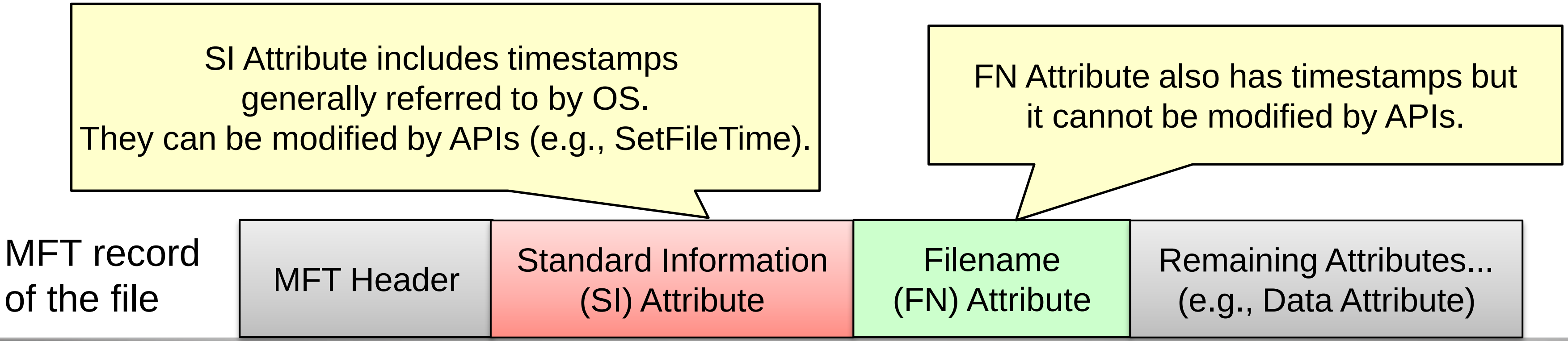
hands-on
Host OS

Bonus Hands-on: Tracking Attacker’s Activities (Cont.)

- Hints for Question1
  - Strategies checking timeline
    - check the period after malware installation
    - check external information to narrow down the time period
      - in this case, “a.7z”
      - check result*.txt
        - » suspicious path
          - » “C:¥Users¥okita¥AppData¥Local¥Temp¥t”
        - » sign of “psexec” execution
          - » “¥PIPE¥psexecsvc” found in “net file” command
    - search “psexec” on timeline

Bonus Hands-on: Tracking Attacker’s Activities (Cont.)

- Hints for Question1
  - timestamps changed by the attacker
    - Two kinds of timestamps in NTFS file system
      - Standard Information (SI) Attribute
      - File Name (FN) Attribute
    - If you want to make timeline with FN attribute timestamps for yourself, you should change log2timeline-sift code
      - http://list-archives.org/2012/07/10/dfir-lists-sans-org/log2timeline-vs-log2timeline-sift/f/4359338113



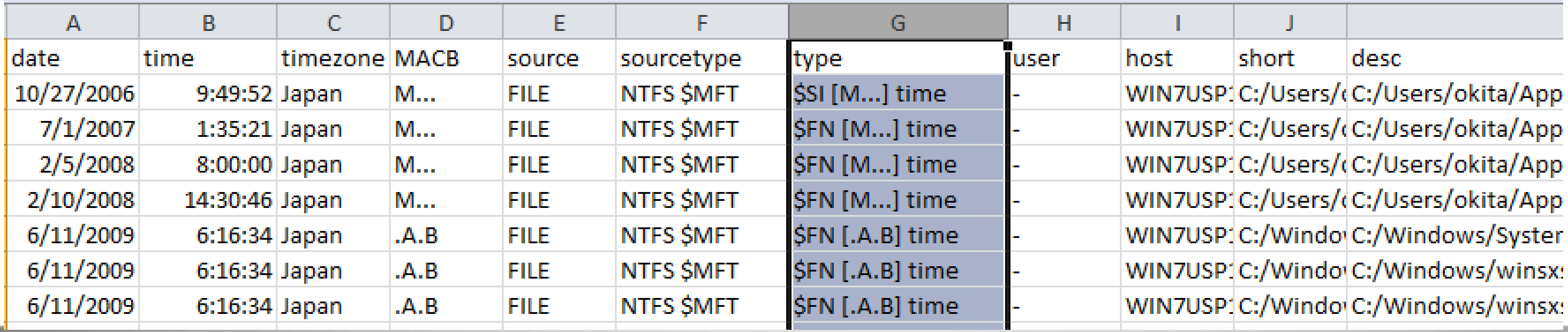
SI Attribute includes timestamps generally referred to by OS.
They can be modified by APIs (e.g., SetFileTime).

FN Attribute also has timestamps but it cannot be modified by APIs.

MFT record of the file
MFT Header
Standard Information (SI) Attribute
Filename (FN) Attribute
Remaining Attributes... (e.g., Data Attribute)

Bonus Hands-on: Tracking Attacker’s Activities (Cont.)

- Hints for Question1
  - Extract and check the timeline with FN timestamps
    - "C:¥IIJ_Hands-on¥WinHost¥timeline¥win7usp1-current-with-fn¥20120901-win7usp1_bodyfile_with-fn.csv.zip“
  - Search one of the tool names (e.g., “psexec”)
    - check the FN attribute timestamp
      - You can differentiate kinds of file system timestamp by means of type(G) column



A	B	C	D	E	F	G	H	I	J	
date	time	timezone	MACB	source	sourcetype	type	user	host	short	desc
10/27/2006	9:49:52	Japan	M...	FILE	NTFS $MFT	$SI [M...] time	-	WIN7USP1	C:/Users/	C:/Users/okita/App
7/1/2007	1:35:21	Japan	M...	FILE	NTFS $MFT	$FN [M...] time	-	WIN7USP1	C:/Users/	C:/Users/okita/App
2/5/2008	8:00:00	Japan	M...	FILE	NTFS $MFT	$FN [M...] time	-	WIN7USP1	C:/Users/	C:/Users/okita/App
2/10/2008	14:30:46	Japan	M...	FILE	NTFS $MFT	$FN [M...] time	-	WIN7USP1	C:/Users/	C:/Users/okita/App
6/11/2009	6:16:34	Japan	.A.B	FILE	NTFS $MFT	$FN [.A.B] time	-	WIN7USP1	C:/Windo	C:/Windows/Syster
6/11/2009	6:16:34	Japan	.A.B	FILE	NTFS $MFT	$FN [.A.B] time	-	WIN7USP1	C:/Windo	C:/Windows/winsx
6/11/2009	6:16:34	Japan	.A.B	FILE	NTFS $MFT	$FN [.A.B] time	-	WIN7USP1	C:/Windo	C:/Windows/winsx

Bonus Hands-on: Tracking Attacker’s Activities (Cont.)

- Question2
  - Examine post-infection activities
    - Can you find “a.7z”?
      - Any other leaked files?

hands-on
Host OS

Bonus Hands-on: Tracking Attacker's Activities (Cont.)

- Hints for Question2
  - overwritten file meta data or securely deleted files
    - Restore files from Volume Shadow Copy
      - Windows Approach (Windows 7/Server 2008 required)
        - » Convert the dd image to vhd format (image backup recommended)
          - » vhdtool /convert <filename>
            - » C:¥IIJ_Hands-on¥WinHost¥tools¥vhdtools
        - » Mount the vhd image
          - » "Attach VHD" in Disk Management
        - » Check VSCs and export files
          - » ShadowKit
            - » C:¥IIJ_Hands-on¥WinHost¥tools¥ShadowKit_Portable_v1.5
      - SANS SIFT Workstation's Approach
        - » Calculate the disk offset to mount
          - » fdisk –lu <filename>
        - » Extract VSCs
          - » vshadowmount –o <disk_offset_value>
        - » Check VSCs and export files
          - » log2timeline-sift and TSK
        - » The generated VSC timeline is located in "C:¥IIJ_Hands-on¥WinHost¥timeline¥win7usp1-vss3¥20120901-vss3-bodyfile.zip"

The image will be overwritten without confirmation!

Don't run twice!

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Timeline of the Incident

See the answer slide

Wrap-up

- Forensic investigation and malware analysis combination can clear
  - root cause of malware infection
  - malware type/functions
  - post-infection activities
- Practical disk image is more chaotic
  - high-capacity disk, many unknown binaries
  - data loss over long term
  - evidence contamination by first responders
- Free tools have reasonable functions, but commercial tools often work effectively
  - IDA Pro
  - EnCase/X-Ways Forensics
  - etc..
- IMPORTANT: delete the disk image after hands-on

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Ongoing Innovation

URL Reference

- Forensic Analysis
  - OS
    - SANS SIFT Forensic Workstation
      - http://computer-forensics.sans.org/community/downloads
  - Timeline Creation
    - log2timeline-sift
      - blogs.sans.org/computer-forensics/files/2012/06/SANS-Digital-Forensics-and-Incident-Response-Poster-2012.pdf
      - http://computer-forensics.sans.org/blog/2011/12/16/digital-forensics-sifting-cheating-timelines-with-log2timeline
      - http://computer-forensics.sans.org/blog/2011/12/07/digital-forensic-sifting-super-timeline-analysis-and-creation
      - http://computer-forensics.sans.org/blog/2011/11/30/log2timeline-plugin-creation
    - log2timeline
      - http://code.google.com/p/log2timeline/
    - Adding $fn（$filename）attribute timestamps
      - http://list-archives.org/2012/07/10/dfir-lists-sans-org/log2timeline-vs-log2timeline-sift/f/4359338113
  - File System Analysis
    - Digital Forensic Framework
      - http://www.digital-forensic.org/
    - TSK
      - http://www.sleuthkit.org/
  - Checking Program Execution Cache
    - Prefetch Parser
      - http://computer-forensics.sans.org/blog/2010/02/12/prefetch-parser-v1-4/
    - ShimCacheParser
      - https://github.com/mandiant/ShimCacheParser
  - Volume Shadow Copy Analysis
    - Accessing Volume Shadow Copies
      - http://windowsir.blogspot.jp/2011/01/accessing-volume-shadow-copies.html
    - Shadow Timelines And Other VolumeShadowCopy Digital Forensics Techniques with the Sleuthkit on Windows
      - http://computer-forensics.sans.org/blog/2011/09/16/shadow-timelines-and-other-shadowvolumecopy-digital-forensics-techniques-with-the-sleuthkit-on-windows
    - ShadowKit
      - http://redrocktx.blogspot.jp/p/shadowkit.html

URL Reference (Cont.)

- Forensic Analysis
  - Registry Analysis
    - Registry Decoder
      - http://www.digitalforensicssolutions.com/registrydecoder/
  - Web History Analysis
    - IECacheView
      - http://www.nirsoft.net/utils/ie_cache_viewer.html
    - IEHistoryView
      - http://www.nirsoft.net/utils/iehv.html
    - Web historian
      - http://www.mandiant.com/resources/download/web-historian
  - Detecting Suspicious Auto-start Programs
    - Autoruns
      - http://technet.microsoft.com/ja-jp/sysinternals/bb963902.aspx
  - Disk Image Mounting
    - FTK Imager
      - http://accessdata.com/support/product-downloads
    - OSFMount
      - http://www.osforensics.com/tools/mount-disk-images.html
  - Event Log Analysis
    - Event Viewer
    - Event Log Explorer
      - http://www.eventlogxp.com/
  - Image Format Conversion
    - qemu-img
      - https://access.redhat.com/knowledge/docs/ja-JP/Red_Hat_Enterprise_Linux/5/html/Virtualization/sect-Virtualization-Tips_and_tricks-Using_qemu_img.html
    - FTK Imager
      - http://accessdata.com/support/product-downloads
    - vhdtool
      - http://archive.msdn.microsoft.com/vhdtool

URL Reference (Cont.)

- Malware Analysis
  - Observing process/file system/network
    - process monitor
      - http://technet.microsoft.com/ja-jp/sysinternals/bb896645.aspx
    - process explorer
      - http://technet.microsoft.com/ja-jp/sysinternals/bb896653.aspx
    - process hacker
      - http://processhacker.sourceforge.net/
    - captureBAT
      - http://www.honeynet.org/node/315
    - API Monitor
      - http://www.rohitab.com/apimonitor
  - Checking difference after malware execution
    - regshot
      - http://sourceforge.net/projects/regshot/
  - Network Analysis during malware execution
    - Wireshark
      - http://www.wireshark.org/
  - Simulating internet servers
    - InetSim
      - http://www.inetsim.org/
    - FakeNet
      - http://practicalmalwareanalysis.com/fakenet/

URL Reference (Cont.)

- Malware Analysis
  - Code Analysis
    - CFF Explorer
      - http://www.ntcore.com/exsuite.php
    - IDA Pro 5.0 Free
      - http://www.hex-rays.com/products/ida/support/download_freeware.shtml
    - OllyDbg
      - http://www.ollydbg.de/
    - Immunity Debugger
      - http://debugger.immunityinc.com/
    - libemu
      - http://libemu.carnivore.it/
    - Malzilla
      - http://malzilla.sourceforge.net/
  - Binary Editor
    - FileInsight
      - http://www.mcafee.com/us/downloads/free-tools/fileinsight.aspx
  - Javascript Analysis
    - jsunpack-n
      - https://code.google.com/p/jsunpack-n/
    - Revelo
      - http://www.kahusecurity.com/2012/revelo-javascript-deobfuscator/
    - Malzilla
      - http://malzilla.sourceforge.net/
  - PDF Analysis
    - http://computer-forensics.sans.org/blog/2011/05/04/extract-flash-from-malicious-pdf-files/
    - PDF Stream Dumper
      - http://sandsprite.com/blogs/index.php?uid=7&pid=57
      - http://blog.zeltser.com/post/3235995383/pdf-stream-dumper-malicious-file-analysis
      - http://www.kahusecurity.com/2011/pdf-analysis-using-pdfstreamdumper/
    - peepdf
      - http://eternal-todo.com/tools/peepdf-pdf-analysis-tool

URL Reference (Cont.)

- Malware Analysis
  - Analyzing MS Office documents
    - OfficeMalScanner
      - http://www.reconstructer.org/code.html
    - offvis
      - http://www.microsoft.com/en-us/download/details.aspx?id=2096
  - Flash Analysis
    - AS3 Sorcerer
      - http://www.as3sorcerer.com/
    - SWFTOOLS
      - http://www.swftools.org/
      - http://securitylabs.websense.com/content/Blogs/3165.aspx
    - SWFREtools
      - https://github.com/sporst/SWFREtools/
      - http://www.google.co.jp/search?q=malicious+swf+analysis&ie=utf-8&oe=utf-8&hl=ja&client=ubuntu&channel=fs
    - SWFInvestigator
      - http://labs.adobe.com/technologies/swfinvestigator/
  - JAVA Analysis
    - jad
      - http://www.varaneckas.com/jad/
    - jd
      - http://java.decompiler.free.fr/?q=jdgui

URL Reference (Cont.)

- Exploit
  - CVE-2012-1535
    - http://contagiodump.blogspot.jp/2012/08/cve-2012-1535-samples-and-info.html
    - http://contagio.deependresearch.org/docs/CVE-2012-1535-Adobe-Flash-Player-Integer-Overflow-Vulnerability-Analysis.pdf
    - http://labs.alienvault.com/labs/index.php/2012/cve-2012-1535-adobe-flash-being-exploited-in-the-wild/
  - CVE-2011-1249 (MS11-046)
    - http://www.exploit-db.com/wp-content/themes/exploit/docs/18712.pdf

Book Reference

- Forensic Analysis
  - File System Forensic Analysis
  - Windows Forensic Analysis DVD Toolkit
  - Mastering Windows Network Forensics and Investigation
- Malware Analysis, Reverse-Engineering
  - Rootkits: Subverting the Windows Kernel
  - The Rootkit Arsenal
  - Malware Analyst's Cookbook and DVD
  - Practical Malware Analysis
  - IDA Pro Book
  - Reversing: Secrets of Reverse Engineering
  - Windows Internals