Digital Forensics and Incident Response

POSTER

FALL 2012 – 22ND EDITION

http://computer-forensics.sans.org

Windows Time Rules

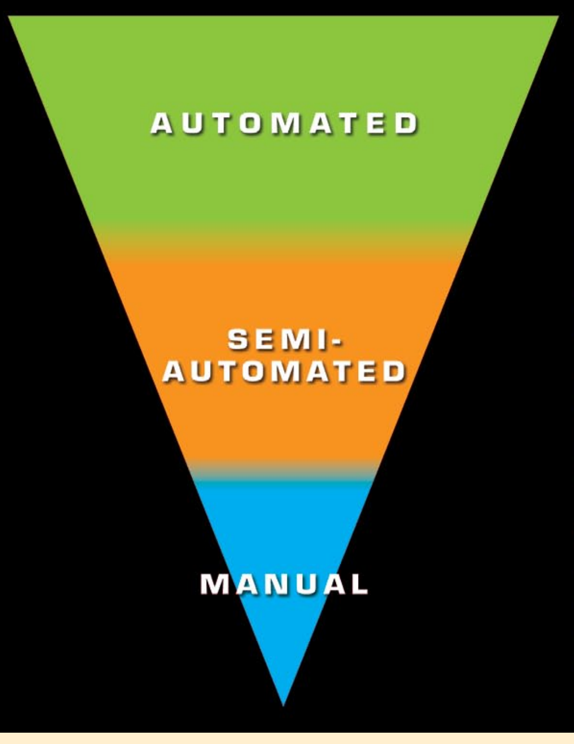
$STDINFO

File Rename	Local File Move	Volume File Move	File Copy	File Access	File Modify	File Creation	File Deletion
Modified – No Change	Modified – No Change	Modified – No Change	Modified – No Change	Modified – No Change	Modified – Change	Modified – Change	Modified – No Change
Access – No Change	Access – No Change	Access – Change	Access – Change	Access – Change *No Change on Vista/Win7*	Access – No Change	Access – Change	Access – No Change
Creation – No Change	Creation – No Change	Creation – No Change	Creation – Change	Creation – No Change	Creation – No Change	Creation – Change	Creation – No Change
Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – No Change

$FILENAME

File Rename	Local File Move	Volume File Move	File Copy	File Access	File Modify	File Creation	File Deletion
Modified – No Change	Modified – Change	Modified – Change	Modified – Change	Modified – No Change	Modified – No Change	Modified – Change	Modified – No Change
Access – No Change	Access – No Change	Access – Change	Access – Change	Access – No Change	Access – No Change	Access – Change	Access – No Change
Creation – No Change	Creation – No Change	Creation – Change	Creation – Change	Creation – No Change	Creation – No Change	Creation – Change	Creation – No Change
Metadata – No Change	Metadata – Changed	Metadata – Changed	Metadata – Changed	Metadata – No Change	Metadata – No Change	Metadata – Changed	Metadata – No Change

Finding Unknown Malware – Step-By-Step



- Prep Evidence/Data Reduction
- Anti-Virus Checks
- Indicators of Compromise Search
- Automated Memory Analysis
- Evidence of Persistence
- Packing/Entropy Check
- Logs
- Super Timeline Examination
- By-Hand Memory Analysis
- By-Hand 3rd Party Hash Lookups
- MFT Anomalies
- File-Time Anomalies

Finding unknown malware is an intimidating process to many, but can be simplified by following some simple steps to help narrow your search. This is not an easy process, but using the techniques in this chart you will learn how to narrow the 80,000 files on a typical machine down to the 1-4 files that is possible malware. This process of Malware Funneling is key to your quick and efficient analysis of compromised hosts and will involve most of the skills you have built up across both FOR408 Windows Forensics and FOR508 Advanced Forensics and Incident Response

STEP 1: Prep Evidence/Data Reduction

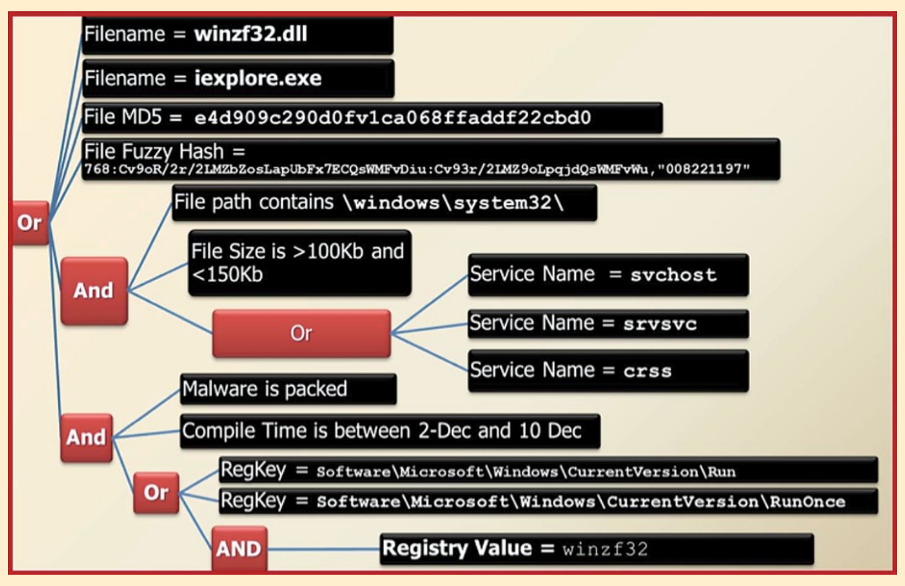
- **Carve and Reduce Evidence**
  - Gather Hash List from similar system (NSRL, md5deep)
  - Carve/Extract all **.exe** and **.dll** files from unallocated space
    - **foremost**
    - **sorter** (exe directory)
    - **bulk_extractor**
- **Prep Evidence**
  - Mount evidence image in Read-Only Mode
  - Locate memory image you collected
  - Optional: Convert **hiberfil.sys** (if it exists to raw memory image) using volatility

STEP 2: Anti-Virus Checks

Run the mounted drive through an Anti Virus Scanner with the latest updates.

Anti-virus scanners employ hundreds of thousands of signatures that can quickly identify well-known malware on a system. First, download the latest anti-virus signatures and mount your evidence for analysis. Use a "deep" scan when available and consider scanning your mounted drive with multiple anti-virus engines to take advantage of their scanning and signature differences. Get in the habit of scanning files exported from your images such as deleted files, data carving results, Sorter output, and email attachments. While anti-virus will not be effective on 0-day or unknown malware, it will easily find the low hanging fruit.

STEP 3: Indicators of Compromise Search

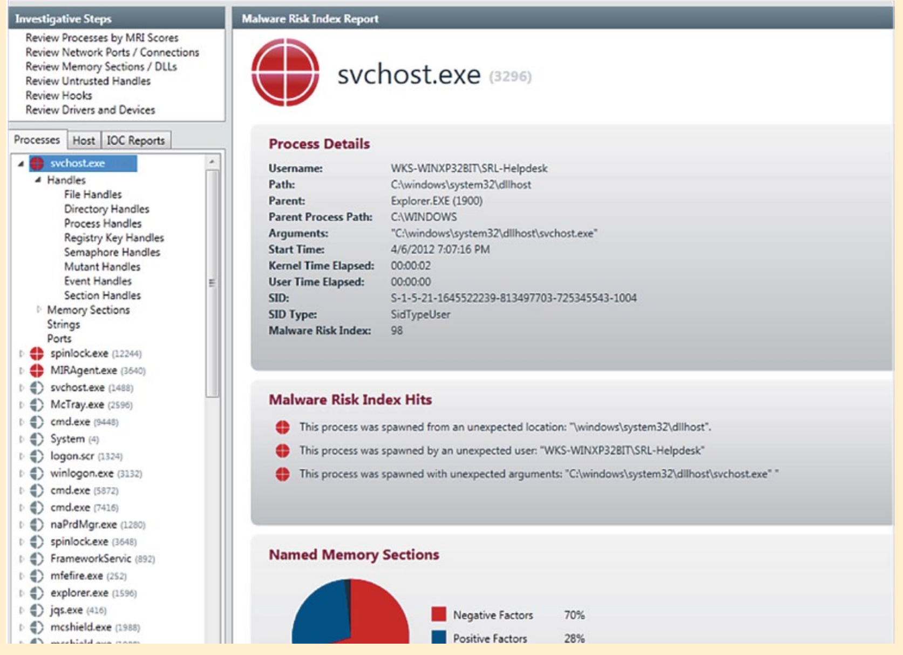


```
Or
  Filename = winzf32.dll
  Filename = iexplore.exe
  File MD5 = e4d909c290d0fv1ca068ffaddf22cbd0
  File Fuzzy Hash =
  768:Cv9oR/2r/2LMZbZosLapUbFx7ECQsWMFvDiu:Cv93r/2LMZ9oLpqjdQsWMFvWu,"008221197"
  And
    File path contains \windows\system32\
    File Size is >100Kb and <150Kb
    Or
      Service Name = svchost
      Service Name = srvsvc
      Service Name = crss
  And
    Malware is packed
    Compile Time is between 2-Dec and 10 Dec
    Or
      RegKey = Software\Microsoft\Windows\CurrentVersion\Run
      RegKey = Software\Microsoft\Windows\CurrentVersion\RunOnce
    AND
      Registry Value = winzf32
```

Using indicators of compromise (IOCs) is a very powerful technique to identify malware components on a compromised host. IOCs are implemented as a combination of boolean expressions that identify specific characteristics of malware. If these characteristics are found, then you may have a hit. An IOC should be general enough to find modified versions of the same malware, but specific enough to limit false positives. There are two types of indicators: Host based (shown above), and Network based (similar to snort signatures plus additional data). The best IOCs are usually created by reversing malware and application behavioral analysis.

What Works?
OpenIOC Framework - **openioc.org**
IOC Editor
IOC Finder
YARA Project

STEP 4: Automated Memory Analysis



Process Details

Username:	WKS-WINXP32BIT\SRL-Helpdesk
Path:	C:\windows\system32\dllhost
Parent:	Explorer.EXE (1900)
Parent Process Path:	C:\WINDOWS
Arguments:	"C:\windows\system32\dllhost\svchost.exe"
Start Time:	4/6/2012 7:07:16 PM
Kernel Time Elapsed:	00:00:02
User Time Elapsed:	00:00:00
SID:	S-1-5-21-1645522239-813497703-725345543-1004
SID Type:	SidTypeUser
Malware Risk Index:	98

Malware Risk Index Hits

- This process was spawned from an unexpected location: "\windows\system32\dllhost".
- This process was spawned by an unexpected user: "WKS-WINXP32BIT\SRL-Helpdesk"
- This process was spawned with unexpected arguments: "C:\windows\system32\dllhost\svchost.exe" "

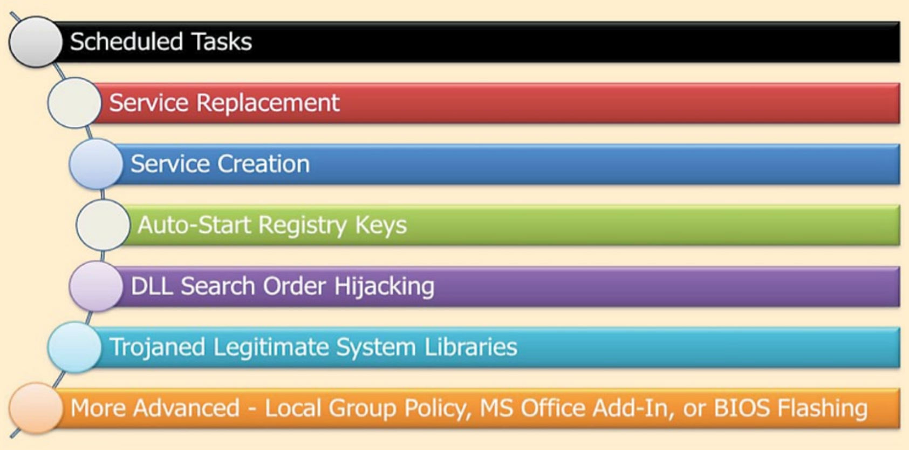
Named Memory Sections

Negative Factors	70%
Positive Factors	28%

- **Behavior Ruleset**
  - Code injection detection
  - Process Image Path Verification
    - **svchost** outside **system32 = Bad**
  - Process User Verification (SIDs)
    - **dllhost** running as **admin = Bad**
  - Process Handle Inspection
    - **iexplore.exe** opening **cmd.exe = Bad**
    - **)!voqa.i4** = known Poison Ivy mutant
- **Verify Digital Signatures**
  - Only available during live analysis
  - Executable, DLL, and driver sig checks
  - Not signed?
    - Is it found in >75% of all processes?

What Works?
MANDIANT Redline
www.mandiant.com/products/free_software/redline
Volatility Malfind:
http://code.google.com/p/volatility

STEP 5: Evidence of Persistence

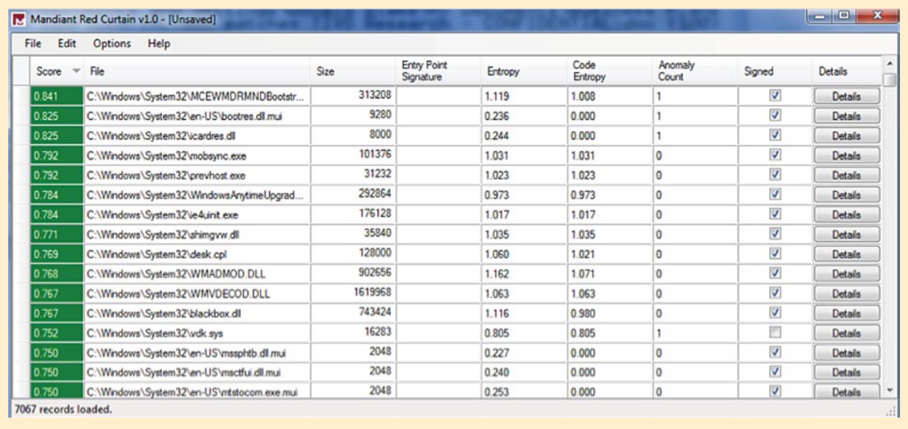


- Scheduled Tasks
- Service Replacement
- Service Creation
- Auto-Start Registry Keys
- DLL Search Order Hijacking
- Trojaned Legitimate System Libraries
- More Advanced - Local Group Policy, MS Office Add-In, or BIOS Flashing

Malware wants to hide, but it also wants to survive a reboot. Malware persistence is extremely common and is an excellent way to find hidden malware. Persistence comes in many forms. The simplest mechanism is via scheduled tasks and the "at" command. Other popular persistence mechanisms include Windows Services and auto-start locations. An adversary can run their malware as a new service or even replace an existing service. There are numerous Windows Registry mechanisms to auto-start an executable at boot or login. Using a tool called autorunsc.exe will easily parse the autostart locations across scheduled tasks, services, and registry keys. While these are the most common, keep in mind there are more advanced techniques. For example the Mebromi malware even flashes the BIOS to persist. Attacks of this nature are rare because even the simplest of techniques are effective, allowing attackers to maintain persistence for long periods of time without being discovered.

What Works? Autorunsc.exe from Microsoft sysinternals
http://technet.microsoft.com/en-us/sysinternals/bb963902

STEP 6: Packing/Entropy Check



Score	File	Size	Entry Point Signature	Entropy	Code Entropy	Anomaly Count	Signed	Details
0.841	C:\Windows\System32\MCEWMDRMNDBootstr...	313208		1.119	1.008	1	☑	Details
0.825	C:\Windows\System32\en-US\bootres.dll.mui	9280		0.236	0.000	1	☑	Details
0.825	C:\Windows\System32\cardres.dll	8000		0.244	0.000	1	☑	Details
0.792	C:\Windows\System32\mobsync.exe	101376		1.031	1.031	0	☑	Details
0.792	C:\Windows\System32\prevhost.exe	31232		1.023	1.023	0	☑	Details
0.784	C:\Windows\System32\WindowsAnytimeUpgrad...	292864		0.973	0.973	0	☑	Details
0.784	C:\Windows\System32\ie4uinit.exe	176128		1.017	1.017	0	☑	Details
0.771	C:\Windows\System32\shimgvw.dll	35840		1.035	1.035	0	☑	Details
0.769	C:\Windows\System32\desk.cpl	128000		1.060	1.021	0	☑	Details
0.768	C:\Windows\System32\WMADMOD.DLL	902656		1.162	1.071	0	☑	Details
0.767	C:\Windows\System32\WMVDECOD.DLL	1619968		1.063	1.063	0	☑	Details
0.767	C:\Windows\System32\blackbox.dll	743424		1.116	0.980	0	☑	Details
0.752	C:\Windows\System32\vdk.sys	16283		0.805	0.805	1	☐	Details
0.750	C:\Windows\System32\en-US\mssphtb.dll.mui	2048		0.227	0.000	0	☑	Details
0.750	C:\Windows\System32\en-US\msctfui.dll.mui	2048		0.240	0.000	0	☑	Details
0.750	C:\Windows\System32\en-US\mtstocom.exe.mui	2048		0.253	0.000	0	☑	Details

7067 records loaded.

- **Scan the file system or common locations for possible malware**
  - Indication of packing
  - Entropy test
  - Compiler and packing signatures identification
  - Digital signature or signed driver checks

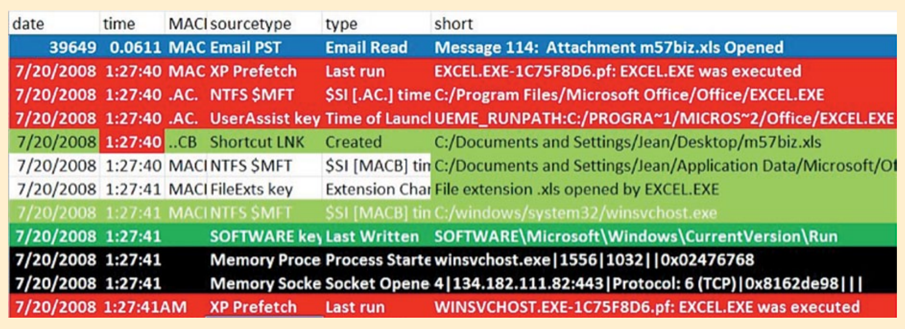
What Works?
MANDIANT Red-Curtain **http://www.mandiant.com/resources/download/red-curtain**
DensityScout **http://cert.at/downloads/software/densityscout_en.html**
Sigcheck - **http://technet.microsoft.com/en-us/sysinternals/bb897441**

STEP 7: Review Event Logs

Scheduled Tasks Log	• Systemroot/SchedLgu.txt • Win7: C:\Windows\Tasks\SchedLgu.txt
Logon Events	•528 – Successful Logon – 4624 Server2008//Win7 •529 – Failed Logon – 4625 Server2008/Win7 •538 – Successful Logoff •540 – Successful Network Logon (example: file shares) -4624 Server 2008//Win7
Account Logon Events	•680 | 4776: Successful / Failed account authentication •672 | 4768: Ticket Granting Ticket was issued (successful logon) •675 | 4771: Pre-authentication failed (failed logon)
Rogue Local Accounts	•680 | 4776 indicates that the an account successfully authenticated •540 | 4624 shows a successful network logon immediately following
Suspicious Services	•7034 – Service crashed unexpectedly •7035 – Service sent a Start / Stop control •7036 – Service started or stopped •7040 – Start type changed (Boot | On Request | Disabled)
Clearing Event Logs	• Event ID 517

What Works?
logparser - **http://www.microsoft.com/download/en/details.aspx?id=24659**
Event Log Explorer - **http://eventlogxp.com**
Log Parser Lizard - **http://www.lizard-labs.net**

STEP 8: Super Timeline Examination



date	time	MACI	sourcetype	type	short
39649	0.0611	MAC	Email PST	Email Read	Message 114: Attachment m57biz.xls Opened
7/20/2008	1:27:40	MAC	XP Prefetch	Last run	EXCEL.EXE-1C75F8D6.pf: EXCEL.EXE was executed
7/20/2008	1:27:40	.AC.	NTFS $MFT	$SI [.AC.] time	C:/Program Files/Microsoft Office/Office/EXCEL.EXE
7/20/2008	1:27:40	.AC.	UserAssist key	Time of Launcl	UEME_RUNPATH:C:/PROGRA~1/MICROS~2/Office/EXCEL.EXE
7/20/2008	1:27:40	..CB	Shortcut LNK	Created	C:/Documents and Settings/Jean/Desktop/m57biz.xls
7/20/2008	1:27:40	MACI	NTFS $MFT	$SI [MACB] tin	C:/Documents and Settings/Jean/Application Data/Microsoft/Of
7/20/2008	1:27:41	MACI	FileExts key	Extension Char	File extension .xls opened by EXCEL.EXE
7/20/2008	1:27:41	MACI	NTFS $MFT	$SI [MACB] tin	C:/windows/system32/winsvchost.exe
7/20/2008	1:27:41		SOFTWARE key	Last Written	SOFTWARE\Microsoft\Windows\CurrentVersion\Run
7/20/2008	1:27:41		Memory Proce	Process Starte	winsvchost.exe|1556|1032||0x02476768
7/20/2008	1:27:41		Memory Socke	Socket Opene	4|134.182.111.82:443|Protocol: 6 (TCP)|0x8162de98|||
7/20/2008	1:27:41AM		XP Prefetch	Last run	WINSVCHOST.EXE-1C75F8D6.pf: EXCEL.EXE was executed

Once you are down to about 10-20 candidates, it is a good time to identify where those files show up in your timeline. The additional context of seeing other files in close temporal proximity to your candidates allows you to identify false positives and focus on those files most likely to be malicious. In the above example, we see the creation of the file winsvchost.exe in the C:\Windows\System32\ directory. If this were one of your candidate files, you would clearly see artifacts that indicate a spearphishing attack surrounding that file's creation time. Notably, an .XLS file was opened via email, winsvchost.exe was executed, an auto-start persistence mechanism was created and finally, a network socket was opened. All within one second! Contextual clues in temporal proximity to the files you are examining are quite useful in your overall case.

What Works? log2timeline found in SIFT Workstation
http://computer-forensics.sans.org/community/downloads

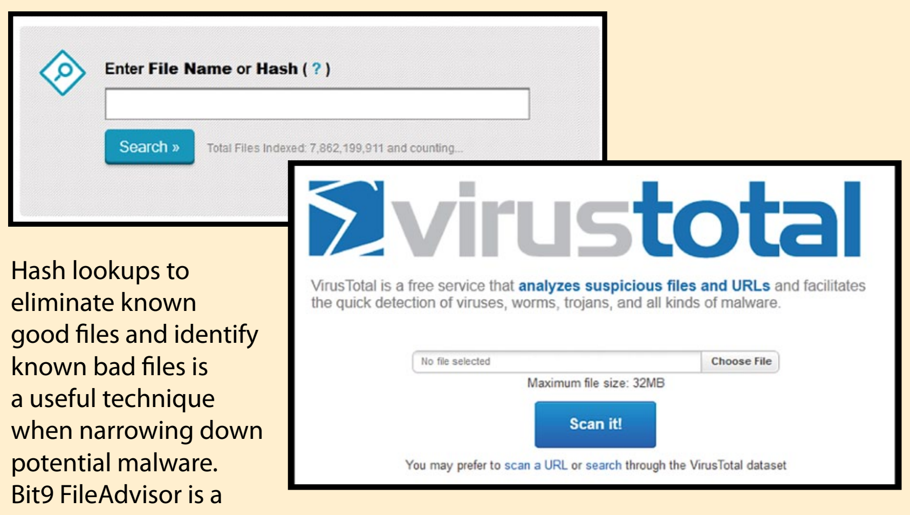
STEP 9: By-Hand Memory Analysis

1. • **Identify rogue processes**
   • Name, path, parent, command line, start time, SIDs
2. • **Analyze process DLLs and handles**
3. • **Review network artifacts**
   • Suspicious ports, connections, and processes
4. • **Look for evidence of code injection**
   • Injected memory sections and process hollowing
5. • **Check for signs of a rootkit**
   • SSDT, IDT, IRP, and inline hooks
6. • **Dump suspicious processes and drivers**
   • Review strings, anti-virus scan, reverse-engineer

Memory analysis is one of the most powerful tools for finding malware. Malware has to run to be effective, creating a footprint that can often be easily discovered via memory forensics. A standard analysis can be broken down into six major steps. Some of these steps might be conducted during incident response, but using a memory image gives deeper insight and overcomes any rootkit techniques that malware uses to protect itself. Memory analysis tools are operating system specific. Since each tool gathers and displays information differently, use multiple tools to check your results.

What Works? Volatility **http://code.google.com/p/volatility**
Mandiant Redline **www.mandiant.com/products/free_software/redline**

STEP 10: By-Hand 3rd Party Hash Lookups


Enter File Name or Hash (?)
Search »
Total Files Indexed: 7,862,199,911 and counting...
virustotal
No file selected
Choose File
Maximum file size: 32MB
Scan it!

VirusTotal is a free service that **analyzes suspicious files and URLs** and facilitates the quick detection of viruses, worms, trojans, and all kinds of malware.

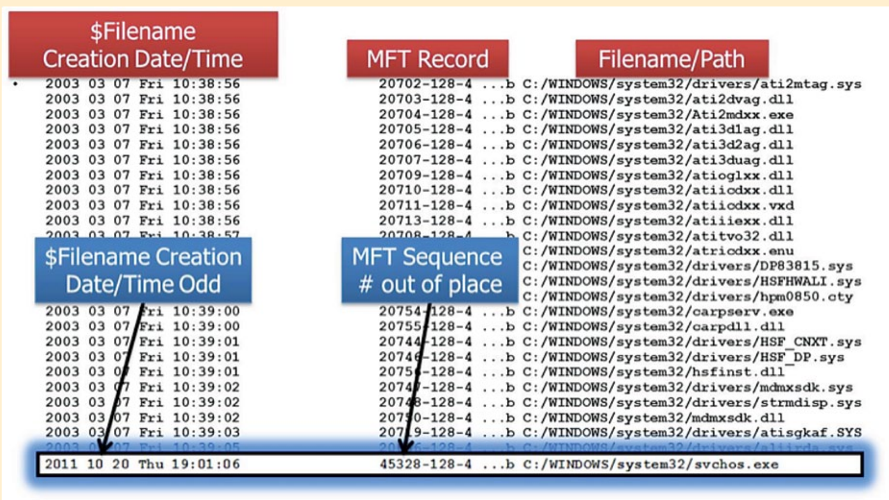
You may prefer to scan a URL or search through the VirusTotal dataset

Hash lookups to eliminate known good files and identify known bad files is a useful technique when narrowing down potential malware. Bit9 FileAdvisor is a free search engine for querying Bit9's application whitelisting database. It is available via online lookup, as well as via a downloadable utility (**http://fileadvisor.bit9.com/services/wu/latest/FileAdvisor.msi**). The National Software Reference Library also provides a robust set of known good hashes for use.

VirusTotal will scan a file through over 40 different A/V scanners to determine if any of the current signatures detect the malware. VirusTotal also allows its database to be searched via MD5 hashes, returning prior analyses for candidate files with the same MD5.

What Works?
VirusTotal **www.virustotal.com** and bit9 **http://fileadvisor.bit9.com**
NSRL Query **http://nsrlquery.sourceforge.net**

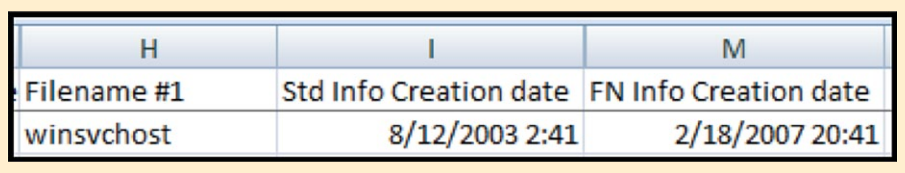
STEP 11: MFT Anomalies


$Filename Creation Date/Time
MFT Record
Filename/Path
$Filename Creation Date/Time Odd
MFT Sequence # out of place

```
2003 03 07 Fri 10:38:56   20702-128-4 ...b C:/WINDOWS/system32/drivers/ati2mtag.sys
2003 03 07 Fri 10:38:56   20703-128-4 ...b C:/WINDOWS/system32/ati2dvag.dll
2003 03 07 Fri 10:38:56   20704-128-4 ...b C:/WINDOWS/system32/Ati2mdxx.exe
2003 03 07 Fri 10:38:56   20705-128-4 ...b C:/WINDOWS/system32/ati3d1ag.dll
2003 03 07 Fri 10:38:56   20706-128-4 ...b C:/WINDOWS/system32/ati3d2ag.dll
2003 03 07 Fri 10:38:56   20707-128-4 ...b C:/WINDOWS/system32/ati3duag.dll
2003 03 07 Fri 10:38:56   20709-128-4 ...b C:/WINDOWS/system32/atioglxx.dll
2003 03 07 Fri 10:38:56   20710-128-4 ...b C:/WINDOWS/system32/atiicdxx.dll
2003 03 07 Fri 10:38:56   20711-128-4 ...b C:/WINDOWS/system32/atiicdxx.vxd
2003 03 07 Fri 10:38:56   20713-128-4 ...b C:/WINDOWS/system32/atiiiexx.dll
2003 03 07 Fri 10:38:57   20708-128-4 ...b C:/WINDOWS/system32/atitvo32.dll
                                           C:/WINDOWS/system32/atricdxx.enu
                                           C:/WINDOWS/system32/drivers/DP83815.sys
                                           C:/WINDOWS/system32/drivers/HSFHWALI.sys
                                           C:/WINDOWS/system32/drivers/hpm0850.cty
2003 03 07 Fri 10:39:00   20754-128-4 ...b C:/WINDOWS/system32/carpserv.exe
2003 03 07 Fri 10:39:00   20755-128-4 ...b C:/WINDOWS/system32/carpdll.dll
2003 03 07 Fri 10:39:01   20744-128-4 ...b C:/WINDOWS/system32/drivers/HSF_CNXT.sys
2003 03 07 Fri 10:39:01   20746-128-4 ...b C:/WINDOWS/system32/drivers/HSF_DP.sys
2003 03 07 Fri 10:39:01   20751-128-4 ...b C:/WINDOWS/system32/hsfinst.dll
2003 03 07 Fri 10:39:02   20747-128-4 ...b C:/WINDOWS/system32/drivers/mdmxsdk.sys
2003 03 07 Fri 10:39:02   20748-128-4 ...b C:/WINDOWS/system32/drivers/strmdisp.sys
2003 03 07 Fri 10:39:02   20750-128-4 ...b C:/WINDOWS/system32/mdmxsdk.dll
2003 03 07 Fri 10:39:03   20749-128-4 ...b C:/WINDOWS/system32/drivers/atisgkaf.SYS
2003 03 07 Fri 10:39:05   20756-128-4 ...b C:/WINDOWS/system32/drivers/aliirda.sys
2011 10 20 Thu 19:01:06   45328-128-4 ...b C:/WINDOWS/system32/svchos.exe
```

A typical file system has hundreds of thousands of files. Each file has its own MFT Record Number. Because of the way operating systems are installed, it's normal to see files under entire directory structures written to disk with largely sequential MFT Record Number values. For example, above is a partial directory listing from a Windows NTFS partition's %system32% directory, sorted by date. Note that the MFT Record Number values are largely sequential and with some exceptions, tend to align with the file creation times. As file systems are used over the years and new patches are applied causing files to be backed up and replaced, the ordering of these files by MFT Record Number numbers can break down. Surprisingly, this ordering remains intact enough on many systems, even after years of use, that we can use it to spot files of interest. This will not happen every time as MFT entries are recycled fairly quickly, but in many cases an outlier can be identified.

STEP 12: File-Time Anomalies



H	I	M
Filename #1	Std Info Creation date	FN Info Creation date
winsvchost	8/12/2003 2:41	2/18/2007 20:41

- **Timestamp Anomalies**
  - $SI Time is before $FN Time
  - Nanoseconds values are all zeroes

One of the ways to tell if file time backdating occurred on a windows machine is to examine the NTFS $Filename times compared to the times stored in $Standard Information. Tools such as timestomp allow a hacker to backdate a file to an arbitrary time of their choosing. Generally, hackers do this only to programs they are trying to hide in the system32 or similar system directories. Those directories and files would be a great place to start. Look to see if the $Filename (FN) creation time occurs after the $Standard Info creation time as this often indicates an anomaly.

What Works?
analyzeMFT.py found on SIFT Workstation and
www.integriography.com
log2timeline found on SIFT Workstation

STEP 13: You Have Malware! Now What?

LEARN REM

- **Hand it to Malware Analyst**
  - FOR610 – RE Malware
  - Hand over sample, relevant configuration files, memory snapshot
- **Typical Output from Malware Analyst**
  - Host-based indicators
  - Network-based indicators
  - Report on malware capabilities and purpose
- **You can now find additional systems compromised by the malware you found**

SANS Digital Forensics and Incident Response

CURRICULUM

Website:
http://computer-forensics.sans.org

Blog

Blogs:
http://computer-forensics.sans.org/blog

SIFT Workstation:
http://computer-forensics.sans.org/community/downloads

REMnux

REMNUX
http://zeltser.com/remnux

Twitter:
www.twitter.com/sansforensics

FOR408
Computer Forensic Investigations – Windows In-Depth
GCFE

FOR508
Advanced Computer Forensic Analysis & Incident Response
GCFA

FOR558
Network Forensics

FOR563
Mobile Device Forensics

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FOR610
REM: Malware Analysis Tools & Techniques
GREM

Additional Forensics Course

FOR526
Windows Memory Forensics In-Depth

SANS

Windows Artifact Analysis: Evidence of…

©2012 SANS – Created by Rob Lee and the SANS DFIR Faculty

Created for FOR408 – Windows Forensics – SANS Digital Forensics and Incident Response faculty created the "Evidence of..." categories to map a specific artifact to the analysis question that it will help to answer. Use this poster as a cheat-sheet to help you remember where you can discover key items to an activity for Microsoft Windows systems for intrusions, intellectual property theft, or common cyber-crimes.

File Download

Open/Save MRU

Description:

In simplest terms, this key tracks files that have been opened or saved within a Windows shell dialog box. This happens to be a big data set, not only including web browsers like Internet Explorer and Firefox, but also a majority of commonly used applications.

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSaveMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePIDlMRU

Interpretation:

- The "*" key – This subkey tracks the most recent files of any extension input in an OpenSave dialog
- .??? (Three letter extension) – This subkey stores file info from the OpenSave dialog by specific extension

E-mail Attachments

Description:

The e-mail industry estimates that 80% of e-mail data is stored via attachments. E-mail standards only allow text. Attachments must be encoded with MIME / base64 format.

Location: Outlook

XP %USERPROFILE%\Local Settings\Application Data\Microsoft\Outlook

Win7 %USERPROFILE%\AppData\Local\Microsoft\Outlook

Interpretation:

MS Outlook data files found in these locations include OST and PST files. One should also check the OLK and Content.Outlook folder which might roam depending on the specific version of Outlook used. For more information on where to find the OLK folder this link has a handy chart: http://www.hancockcomputertech.com/blog/2010/01/06/find-the-microsoft-outlook-temporary-olk-folder

Skype History

Description:

- Skype history keeps a log of chat sessions and files transferred from one machine to another
- This is turned on by default in Skype installations

Location:

XP C:\Documents and Settings\<username>\Application\Skype\<skype-name>

Win7 C:\Users\<username>\AppData\Roaming\Skype\<skype-name>

Interpretation:

Each entry will have a date/time value and a Skype username associated with the action.

Index.dat/ Places.sqlite

Description:

Not directly related to "File Download". Details stored for each local user account. Records number of times visited (frequency).

Location: Internet Explorer

XP %userprofile%\Local Settings\History\ History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\Low\History.IE5

Location: Firefox

IE %userprofile%\Application Data\Mozilla\ Firefox\Profiles\<random text>.default\places.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\ Firefox\Profiles\<random text>.default\places.sqlite

Interpretation:

Many sites in history will list the files that were opened from remote sites and downloaded to the local system. History will record the access to the file on the website that was access via a link.

Downloads.sqlite

Description:

Firefox has a built-in download manager application which keeps a history of every file downloaded by the user. This browser artifact can provide excellent information about what sites a user has been visiting and what kinds of files they have been downloading from them.

Location: Firefox

IE %userprofile%\Application Data\Mozilla\ Firefox\Profiles\<random text>.default\downloads.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\ Firefox\Profiles\<random text>.default\downloads.sqlite

Interpretation:

Downloads.sqlite will include:

- Filename, Size, and Type
- Download from and Referring Page
- File Save Location
- Application Used to Open File
- Download Start and End Times

Program Execution

UserAssist

Description:

GUI-based programs launched from the desktop are tracked in the launcher on a Windows System.

Location: NTUSER.DAT HIVE

NTUSER.DAT\Software\Microsoft\Windows\Currentversion\Explorer\UserAssist\{GUID}\Count

Interpretation:

All values are ROT-13 Encoded

- GUID for XP
  - **75048700** Active Desktop
- GUID for Win7
  - **CEBFF5CD** Executable File Execution
  - **F4E57C4B** Shortcut File Execution
- Program Locations for Win7 Userassist
  - **ProgramFilesX64** 6D809377-…
  - **ProgramFilesX86** 7C5A40EF-…
  - **System** 1AC14E77-…
  - **SystemX86** D65231B0-…
  - **Desktop** B4BFCC3A-…
  - **Documents** FDD39AD0-…
  - **Downloads** 374DE290-…
  - **UserProfiles** 0762D272-…

Last Visited MRU

Description:

Tracks the specific executable used by an application to open the files documented in the OpenSaveMRU key. In addition, each value also tracks the directory location for the last file that was accessed by that application.

Example: Notepad.exe was last run using the C:\Users\<Username>\Desktop folder

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedPidlMRU

Interpretation:

Tracks the application executables used to open files in OpenSaveMRU and the last file path used.

RunMRU Start->Run

Description:

Whenever someone does a Start -> Run command, it will log the entry for the command they executed.

Location: NTUSER.DAT HIVE

NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\RunMRU

Interpretation:

The order in which the commands are executed is listed in the RunMRU list value. The letters represent the order in which the commands were executed.

Application Compatibility Cache

Description:

- Windows Application Compatibility Database is used by Windows to identify possible application compatably challenges with executables.
- Tracks the executables file name, file size, last modified time, and in Windows XP the last update time

Location:

XP SYSTEM\CurrentControlSet\Control\SessionManager\AppCompatibility\

Win7 SYSTEM\CurrentControlSet\Control\Session Manager\AppCompatCache

Interpretation:

Any executable run on the Windows system could be found in this key. You can use this key to identify systems that specific malware was executed on. In addition, based on the interpretation of the time based data you might be able to determine the last time of execution or activity on the system.

- Windows XP contains at most 96 entries
  - LastUpdateTime is updated when the files are executed
- Windows 7 contains at most 1024 entries
  - LastUpdateTime does not exist on Win7 systems

Tool to parse:

MANDIANT's ShimCacheParser

Win7 Jump Lists

Description:

- The Windows 7 task bar (Jump List) is engineered to allow users to "jump" or access items they frequently or have recently used quickly and easily. This functionality cannot only be recent media files, but recent tasks as well.
- The data stored in the AutomaticDestinations folder will each have a unique file prepended with the AppID of the associated application.

Location:

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Windows\Recent\ AutomaticDestinations

Interpretation:

- First time of execution of application.
  - Creation Time = First time item added to the AppID file.
- Last time of execution of application w/file open.
  - Modification Time = Last time item added to the AppID file.
- List of Jump List IDs -> http://www.forensicswiki.org/wiki/List_of_Jump_List_IDs

Prefetch

Description:

- Increases performance of a system by pre-loading code pages of commonly used applications. Cache Manager monitors all files and directories referenced for each application or process and maps them into a .pf file. Utilized to know an application was executed on a system.
- Limited to 128 files on XP and Win7
- (exename)-(hash).pf

Location:

Win7/XP C:\Windows\Prefetch

Interpretation:

- Each .pf will include last time of execution, # of times run, and device and file handles used by the program
- Date/Time File by that name & path was first executed
  - Creation Date of .pf file (-10 seconds)
- Date/Time File by that name & path was last executed
  - Embedded last execution time of .pf file
  - Last Modification Date of .pf file (-10 seconds)

Services Events

Description:

- Analyze logs for suspicious services running at boot time
- Review services started or stopped around the time of a suspected compromise

Location:

All Event IDs reference the System Log

7034 – Service crashed unexpectedly

7035 – Service sent a Start / Stop control

7036 – Service started or stopped

7040 – Start type changed (Boot | On Request | Disabled)

Interpretation:

- A large amount of malware and worms in the wild utilize Services
- Services started on boot illustrate persistence (desirable in malware)
- Services can crash due to attacks like process injection

File Opening / Creation

Open/Save MRU

Description:

In simplest terms, this key tracks files that have been opened or saved within a Windows shell dialog box. This happens to be a big data set, not only including web browsers like Internet Explorer and Firefox, but also a majority of commonly used applications.

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSaveMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePIDlMRU

Interpretation:

- The "*" key – This subkey tracks the most recent files of any extension input in an OpenSave dialog
- .??? (Three letter extension) – This subkey stores file info from the OpenSave dialog by specific extension

Last Visited MRU

Description:

Tracks the specific executable used by an application to open the files documented in the OpenSaveMRU key. In addition, each value also tracks the directory location for the last file that was accessed by that application.

Example: Notepad.exe was last run using the C:\Users\Rob\Desktop folder

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\ LastVisitedMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedPidlMRU

Interpretation:

Tracks the application executables used to open files in OpenSaveMRU and the last file path used.

Recent Files

Description:

Registry Key that will track the last files and folders opened and is used to populate data in "Recent" menus of the Start menu.

Location: NTUSER.DAT

NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs

Interpretation:

- RecentDocs – Overall key will track the overall order of the last 150 files or folders opened. MRU list will keep track of the temporal order in which each file/folder was opened. The last entry and modification time of this key will be time and location of the last file of a specific extension was opened.
- .??? – This subkey stores the last files with a specific extension that were opened. MRU list will keep track of the temporal order in which each file was opened. The last entry and modification time of this key will be time and location of the last file of a specific extension was opened.
- Folder – This subkey stores the last folders that were opened. MRU list will keep track of the temporal order in which each folder was opened. The last entry and modification time of this key will be time and location of the last folder opened.

Office Recent Files

Description:

MS Office programs will track their own Recent Files list to make it easier for the user to remember the last file they were editing.

Location:

NTUSER.DAT\Software\Microsoft\Office\VERSION

- 14.0 = Office 2010
- 12.0 = Office 2007
- 11.0 = Office 2003
- 10.0 = Office XP

Interpretation:

Similar to the Recent Files, this will track the last files that were opened by each MS Office application. The last entry added, per the MRU, will be the time the last file was opened by a specific MS Office application.

Shell bags

Description:

- Can track user window viewing preferences to Windows Explorer
- Can be utilized to tell if activity occurred in a folder
- In some cases, you can see the files from a specific folder as well

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\Shell\Bags

XP NTUSER.DAT\Software\Microsoft\Windows\Shell\BagMRU

XP NTUSER.DAT\Software\Microsoft\Windows\ShellNoRoam\Bags

XP NTUSER.DAT\Software\Microsoft\Windows\ShellNoRoam\BagMRU

Win7 USRCLASS.DAT\Local Settings\Software\Microsoft\Windows\Shell\Bags

Win7 USRCLASS.DAT\Local Settings\Software\Microsoft\Windows\Shell\BagMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\Shell\BagMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\Shell\Bags

Interpretation:

Store information about which folders were most recently browsed by the user.

Shortcut (LNK) Files

Description:

- Shortcut Files automatically created by Windows
  - Recent Items
  - Opening local and remote data files and documents will generate a shortcut file (.lnk)

Location:

XP C:\Documents and Settings\<username>\Recent\

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Windows\Recent\

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Office\Recent\

Note these are primary locations of LNK files. They can also be found in other locations.

Interpretation:

- Date/Time File of that name was first opened
  - Creation Date of Shortcut (LNK) File
- Date/Time File of that name was last opened
  - Last Modification Date of Shortcut (LNK) File
- LNKTarget File (Internal LNK File Information) Data:
  - Modified, Access, and Creation times of the target file
  - Volume Information (Name, Type, Serial Number)
  - Network Share information
  - Original Location
  - Name of System

Win7 Jump Lists

Description:

- The Windows 7 task bar (Jump List) is engineered to allow users to "jump" or access items they frequently or have recently used quickly and easily. This functionality cannot only be recent media files, but recent tasks as well.
- The data stored in the AutomaticDestinations folder will each have a unique file prepended with the AppID of the association application and embedded with LNK files in each stream.

Location:

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Windows\Recent\AutomaticDestinations

Interpretation:

- Using the Structured Storage Viewer open up one of the AutomaticDestination jumplist files.
- Each one of these files is a separate LNK file. They are also stored numerically in order from the earliest one (usually 1) to the most recent (largest integer value).

Prefetch

Description:

- Increases performance of system by pre-loading code pages of commonly used applications. Cache Manger monitors all files and directories referenced for each application or process and maps them into a .pf file. Utilized to know an application was executed on a system.
- Limited to 128 files on XP and Vista/Win7
- (exename)-(hash).pf

Location:

Win7/XP C:\Windows\Prefetch

Interpretation:

- Can examine each .pf file to look for file handles recently used
- Can examine each .pf file to look for device handles recently used

Index.dat file://

Description:

- A little known fact about the IE History is that the information stored in the history files is not just related to Internet browsing. The history also records local and remote (via network shares) file access, giving us an excellent means for determining which files and applications were accessed on the system, day by day.

Location: Internet Explorer

XP %userprofile%\Local Settings\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\Low\History.IE5

Interpretation:

- Stored in index.dat as: file:///C:/directory/filename.ext
- Does not mean file was opened in browser

Deleted File or File Knowledge

XP Search – ACMRU

Description:

You can search for multiple things through the search assistant on a Windows XP machine. The search assistant will remember a user's search terms for filenames, computers, or words that are inside a file. This is an example of where you can find the "Search History" on the Windows system.

Location: NTUSER.DAT HIVE

NTUSER.DAT\Software\Microsoft\Search Assistant\ACMru\####

Interpretation:

- Search the Internet – ####=5001
- All or part of a document name – ####=5603
- A word or phrase in a file – ####=5604
- Printers, Computers and People – ####=5647

Win7 Search – WordWheelQuery

Description:

Keywords searched for from the START menu bar on a Windows 7 machine.

Location: Win7 NTUSER.DAT Hive

NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\WordWheelQuery

Interpretation:

Keywords are added in Unicode and listed in temporal order in an MRUlist

Last Visited MRU

Description:

Tracks the specific executable used by an application to open the files documented in the OpenSaveMRU key. In addition, each value also tracks the directory location for the last file that was accessed by that application.

Location:

XP NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\ LastVisitedMRU

Win7 NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\ LastVisitedPidlMRU

Interpretation:

Tracks the application executables used to open files in OpenSaveMRU and the last file path used.

Thumbs.db

Description:

Hidden file in directory where pictures on Windows XP machine exist. Catalogs all the pictures and stores a copy of the thumbnail even if the pictures were deleted.

Location:

Each directory where pictures resided that were viewed in thumbnail mode. Many camera's also will auto generate a thumbs.db file when you view the pictures on the camera itself.

Interpretation:

Include:

- Thumbnail Picture of Original
- Last Modification Time
- Original Filename

Vista/Win7 Thumbnails

Description:

On Vista/Win7 versions of Windows, thumbs.db does not exist. The data now sits under a single directory for each user of the machine located in their application data directory under their home directory.

Location:

C:\Users\<username>\AppData\Local\Microsoft\Windows\Explorer\

Interpretation:

- These are created when a user switches a folder to thumbnail mode or views pictures via a slide show. As it were, our thumbs are now stored in separate database files. Vista/Win7 has 4 sizes for thumbnails and the files in the cache folder reflect this.
  - 32 -> small
  - 96 -> medium
  - 256 -> large
  - 1024 -> extra large
- The thumbcache will store the thumbnail copy of the picture based on the thumbnail size in the content of the equivalent database file.

XP Recycle Bin

Description:

The recycle bin is a very important location on a Windows file system to understand. It can help you when accomplishing a forensic investigation as every file that is deleted from a Windows recycle bin aware program is generally first put in the recycle bin.

Location:

- Hidden System Folder
- Windows XP
  - C:\RECYCLER" 2000/NT/XP/2003
  - Subfolder is created with user's SID
  - Hidden file in directory called "INFO2"
  - INFO2 Contains Deleted Time and Original Filename
  - Filename in both ASCII and UNICODE

Interpretation:

- SID can be mapped to user via Registry Analysis
- Windows XP
  - INFO2
    - Hidden file in Recycle Bin called INFO2
    - Maps filename to the actual name and path it was deleted from

Win7 Recycle Bin

Description:

The recycle bin is a very important location on a Windows file system to understand. It can help you when accomplishing a forensic investigation as every file that is deleted from a Windows recycle bin aware program is generally first put in the recycle bin.

Location:

- Hidden System Folder
- Windows 7
  - C:\$Recycle.bin
  - Deleted Time and Original Filename contained in separate files for each deleted recovery file

Interpretation:

- SID can be mapped to user via Registry Analysis
- Windows 7
  - Files Preceded by $I###### files contain
    - Original PATH and name
    - Deletion Date/Time
  - Files Preceded $R###### files contain
    - Recovery Data

Index.dat file://

Description:

A little known fact about the IE History is that the information stored in the history files is not just related to Internet browsing. The history also records local and remote (via network shares) file access, giving us an excellent means for determining which files and applications were accessed on the system, day by day.

Interpretation:

- Stored in index.dat as: file:///C:/directory/filename.ext
- Does not mean file was opened in browser

Physical Location

Timezone

Description:

Identifies the current system time zone.

Location: SYSTEM Hive

SYSTEM\CurrentControlSet\Control\TimeZoneInformation

Interpretation:

- Time activity is incredibly useful for correlation of activity
- Internal log files and date/timestamps will be based off of the system time zone information
- You might have other network devices and you will need to correlate information to the Time Zone information collected here.

VISTA/Win7 Network History

Description:

- Identify networks that the computer has been connected to
- Networks could be wireless or wired.
- Identify domain name/intranet name
- Identify SSID
- Identify Gateway MAC Address

Location: SOFTWARE HIVE

- SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\Signatures\Unmanaged
- SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\Signatures\Managed
- SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkList\Nla\Cache

Interpretation:

- Identifying intranets and networks that a computer has connected to is incredibly important
- Not only can you tell the intranet name, you can tell the last time the network was connected to based on the last write time of the key
- This will also list any networks that have been connected to via a VPN
- MAC Address of SSID for Gateway could be physically triangulated

Cookies

Description:

Cookies give insight into what websites have been visited and what activities may have taken place there.

Location: Internet Explorer

XP %userprofile%\Cookies

Win7 %userprofile%\AppData\Roaming\Microsoft\Windows\Cookies

Win7 %userprofile%\AppData\Roaming\Microsoft\Windows\Cookies\Low

Location: Firefox

XP %userprofile%\Application Data\Mozilla\Firefox\Profiles\<random text>.default\cookies.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\Firefox\Profiles\<random text>.default\cookies.sqlite

Browser Search Terms

Description:

Records websites visited by date & time. Details stored for each local user account. Records number of times visited (frequency). Also tracks access of local system files. This will also include the website history of search terms in search engines.

Location: Internet Explorer

XP %userprofile%\Local Settings\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\Low\History.IE5

Location: Firefox

XP %userprofile%\Application Data\Mozilla\Firefox\Profiles\<random text>.default\places.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\Firefox\Profiles\<random text>.default\places.sqlite

Proper digital forensic and incident response analysis is essential to successfully solving complex cases today. Each analyst should examine the artifacts and then analyze the activity that they describe to determine a clear picture of which user was involved, what the user was doing, when they were doing it, and why. The data here will aid you in finding multiple locations that can help substantiate facts related to your casework.

USB or Drive Usage

Key Identification

Description:

Track USB devices plugged into a machine.

Location:

- SYSTEM\CurrentControlSet\Enum\USBSTOR
- SYSTEM\CurrentControlSet\Enum\USB

Interpretation:

- Identify Vendor, Product, and Version of a USB device plugged into a machine
- Identify a unique USB device plugged into the machine
- Determine the time a device was plugged into the machine
- Devices that do not have a unique serial number will have an "&" in the second character of the serial number.

First / Last Times

Description:

Determine temporal usage of specific USB devices connected to a Windows Machine.

Location: First Time

- Plug and Play Log Files

XP C:\Windows\setupapi.log

Win7 C:\Windows\inf\setupapi.dev.log

Interpretation:

- Search for Device Serial Number
- Log File times are set to local time zone

Location: Last Time

- NTUSER.DAT Hive: NTUSER//Software/Microsoft/Windows/CurrentVersion/Explorer/MountPoints2/{GUID}
- Interpretation:
- Using the Serial Number as the marker, you can determine the last time a specific USB device was last connected to the local machine

User

Description:

Find User that used the Unique USB Device.

Location:

- Look for GUID from SYSTEM\MountedDevices
- NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\MountPoints2

Interpretation:

This GUID will be used next to identify the user that plugged in the device. The last write time of this key also corresponds to the last time the device was plugged into the machine by that user. The number will be referenced in the user's personal mountpoint's key in the NTUSER.DAT Hive.

Volume Serial Number

Description:

Discover the Volume Serial Number of the Filesystem Partition on the USB (NOTE: This is not the USB Unique Serial Number, this is created when a filesystem is initially formatted).

Location:

- SOFTWARE\Microsoft\Windows NT\CurrentVersion\ENDMgmt
- Use Volume Name and USB Unique Serial Number to find
- Last integer number in line
- Convert Decimal Serial Number into Hex Serial Number

Interpretation:

- Knowing both the Volume Serial Number and the Volume Name you can correlate the data across SHORTCUT File (LNK) analysis and the RECENTDOCs key.
- The Shortcut File (LNK) contains the Volume Serial Number and Name
- RecentDocs Registry Key, in most cases, will contain the volume name when the "USB Device" is opened via Explorer

Drive Letter and Volume Name

Description:

Discover the drive letter of the USB Device when it was plugged in the machine.

Location: XP

- Find ParentIdPrefix
  - SYSTEM\CurrentControlSet\Enum\USBSTOR
- Using ParentIdPrefix Discover Last Mount Point
  - SYSTEM\MountedDevices

Location: Win7

- SOFTWARE\Microsoft\Windows Portable Devices\Devices
- SYSTEM\MountedDevices
  - Examine Drive Letter's looking at Value Data Looking for Serial Number

Interpretation:

- Identify the USB device that was last mapped to a specific drive letter

Shortcut (LNK) Files

Description:

Shortcut Files automatically created by Windows

- Recent Items
- Open local and remote data files and documents will generate a shortcut file (.lnk)

Location:

XP C:\Documents and Settings\<username>\Recent\

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Windows\Recent\

Win7 C:\Users\<user>\AppData\Roaming\Microsoft\Office\Recent\

Interpretation:

- Date/Time File of that name was first opened
  - Creation Date of Shortcut (LNK) File
- Date/Time File of that name was last opened
  - Last Modification Date of Shortcut (LNK) File
- LNKTarget File (Internal LNK File Information) Data:
  - Modified, Access, and Creation times of the target file
  - Volume Information (Name, Type, Serial Number)
  - Network Share information
  - Original Location
  - Name of System

P&P Event Log

Description:

When a Plug and Play driver install is attempted, the service will log an ID 20001 event and provide a Status within the event. It is important to note that this event will trigger for any Plug and Play-capable device, including but not limited to USB, Firewire, and PCMCIA devices.

Location: System Log File

Win7 %system root%\System32\winevt\logs\System.evtx

Interpretation:

- Event ID: 20001 – Plug and Play driver install attempted
- Event ID 20001
- Timestamp
- Device information
- Device serial num
- Status (0 = no errors)

Account Usage

Last Login

Description:

Lists the local accounts of the system and their equivalent security identifiers.

Location:

- C:\windows\system32\config\SAM
- SAM\Domains\Account\Users

Interpretation:

- Only the last login time will be stored in the registry key

Last Password Change

Description:

Lists the last time the password of a specific user has been changed.

Location:

- C:\windows\system32\config\SAM
- SAM\Domains\Account\Users

Interpretation:

- Only the last password change time will be stored in the registry key

Success / Fail Logons

Description:

Determine which accounts have been used for attempted logons. Track account usage for known compromised accounts.

Location:

XP %system root%\System32\config\SecEvent.evt

Win7 %system root%\System32\winevt\logs\Security.evtx

Interpretation:

- XP/Win7 - Interpretation
- Event ID - 528/4624 – Successful Logon
- Event ID - 529/4625 – Failed Logon
- Event ID - 538/4634 – Successful Logoff
- Event ID - 540/4624 – Successful Network Logon (example: file shares)

Logon Types

Description:

Logon Events can give us very specific information regarding the nature of account authorizations on a system if we know where to look and how to decipher the data that we find. In addition to telling us the date, time, username, hostname, and success/failure status of a logon, we can also determine by exactly what means a logon was attempted.

Location:

XP Event ID 528

Win7 Event ID 4624

Interpretation:

Logon Type	Explanation
2	Logon via console
3	Network Logon
4	Batch Logon
5	Windows Service Logon
7	Credentials used to unlock screen
8	Network logon sending credentials (cleartext)
9	Different credentials used than logged on user
10	Remote interactive logon (RDP)
11	Cached credentials used to logon

RDP Usage

Description:

Track Remote Desktop Protocol logons to target machines.

Location: Security Log

XP %system root%\System32\config\SecEvent.evt

Win7 %system root%\System32\winevt\logs\Security.evtx

Interpretation:

- XP/Win7 - Interpretation
  - Event ID 682/4778 – Session Connected / Reconnected
  - Event ID 683/4779 – Session Disconnected
- Event log provides hostname and IP address of remote machine making the connection
- On workstations you will often see current console session disconnected (683) followed by RDP connection (682)

Each of the rows listed will describe a series of artifacts found on a Windows system to help determine if that action occurred. Usually multiple artifacts will be discovered that will all point to the same activity. These locations are a guide to help you focus your analysis in the right areas in Windows that could aid you in answering simple questions.

Browser Usage

History

Description:

Records websites visited by date & time. Details stored for each local user account. Records number of times visited (frequency). Also tracks access of local system files.

Location: Internet Explorer

XP %userprofile%\Local Settings\History\ History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\History.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\History\Low\History.IE5

Location: Firefox

XP %userprofile%\Application Data\Mozilla\Firefox\Profiles\<random text>.default\places.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\Firefox\Profiles\<random text>.default\places.sqlite

Cookies

Description:

Cookies give insight into what websites have been visited and what activities may have taken place there.

Location: Internet Explorer

XP %userprofile%\Cookies

Win7 %userprofile%\AppData\Roaming\Microsoft\Windows\Cookies

Win7 %userprofile%\AppData\Roaming\Microsoft\Windows\Cookies\Low

Location: Firefox

XP %userprofile%\Application Data\Mozilla\Firefox\Profiles\<random text>.default\cookies.sqlite

Win7 %userprofile%\AppData\Roaming\Mozilla\Firefox\Profiles\<random text>.default\cookies.sqlite

Cache

Description:

- The cache is where web page components can be stored locally to speed up subsequent visits
- Gives the investigator a "snapshot in time" of what a user was looking at online
  - Identifies websites which were visited
  - Provides the actual files the user viewed on a given website
  - Cached files are tied to a specific local user account
  - Timestamps show when the site was first saved and last viewed

Location: Internet Explorer

XP %userprofile%\Local Settings\Temporary Internet Files\Content.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5

Win7 %userprofile%\AppData\Local\Microsoft\Windows\Temporary Internet Files\Low\Content.IE5

Location: Firefox

XP %userprofile%\Local Settings\Application Data\Mozilla\ Firefox\Profiles\<random text>.default\Cache

Win7 %userprofile%\AppData\Local\Mozilla\ Firefox\Profiles\<random text>.default\Cache

Session Restore

Description:

Automatic Crash Recovery features built into the browser.

Location: Internet Explorer

XP %userprofile%/Local Settings/Application Data/Microsoft/Internet Explorer/Recovery

Win7 %userprofile%/AppData/Local/Microsoft/Internet Explorer/Recovery

Location: Firefox

XP %userprofile%\Application Data\Mozilla\Firefox\Profiles\<random text>.default\sessionstore. js

Win7 %userprofile%\AppData\Roaming\Mozilla\Firefox\Profiles\<random text>.default\sessionstore. js

Interpretation:

- Historical websites viewed in each tab
- Referring websites
- Time session ended
- Modified time of .dat files in LastActive folder
- Time each tab opened (only when crash occurred)
- Creation time of .dat files in Active folder

Flash & Super Cookies

Description:

Local Stored Objects (LSOs), or Flash Cookies, have become ubiquitous on most systems due to the extremely high penetration of Flash applications across the Internet. LSOs allow a web application to store information that can later be accessed by that same application (or domain). They tend to be much more persistent since they do not expire and there is no built in mechanism within the browser to remove them. In fact, many sites have begun using LSOs for their tracking mechanisms since they rarely get cleared like traditional cookies.

Location: Internet Explorer

XP %APPDATA%\Macromedia\Flash Player\

XP %APPDATA%\Macromedia\Flash

XP %APPDATA%\Macromedia\Flash Player\macromedia.com\support\flashplayer\sys

Win7 %APPDATA%\Roaming\Macromedia\Flash Player\

Win7 %APPDATA%\Roaming\Macromedia\Flash Player\#SharedObjects\<random profile id>

Win7 %APPDATA%\Roaming\Macromedia\Flash Player\macromedia.com\support\flashplayer\sys

Interpretation:

- Websites visited
- User account used to visit the site
- When cookie was created and last accessed