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Windows Forensics

Computer forensics

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Agenda

- Recycle bin
- Print spool files
- Thumbs.db
- Prefetch
- Swap/Hibernation file
- The Windows Registry
  - → Recent files
  - → USB device history
  - → Registry traces
  - → Various elements
- Restore points

Windows forensic: Recycle bin

- When deleting files normally, they end up in the recycler
  - → Shift+DEL → Deleted immediately!
  - → Something in the recycler → generally deleted intentionally
  - → These files are completely recoverable: Name, content etc.
- Emptying the recycle bin:
  - → The saved files are actually deleted; just like normal files
    - » Their directory entries within thee recycler folder remain
    - » Their data remains on the disk until overwritten
  - → The INFO2 file (see later) is deleted and a new one recreated
    - » Sometimes only shortened, i.e. the record numbers continue
- Deleting a single file from the recycle bin
  - → Changes the first byte of the record to '00'
    - » This is typically the drive letter, which can be recreated from the drive number within the record!
- Note: Removable media does not have a recycle bin!

Windows forensic: Recycle bin

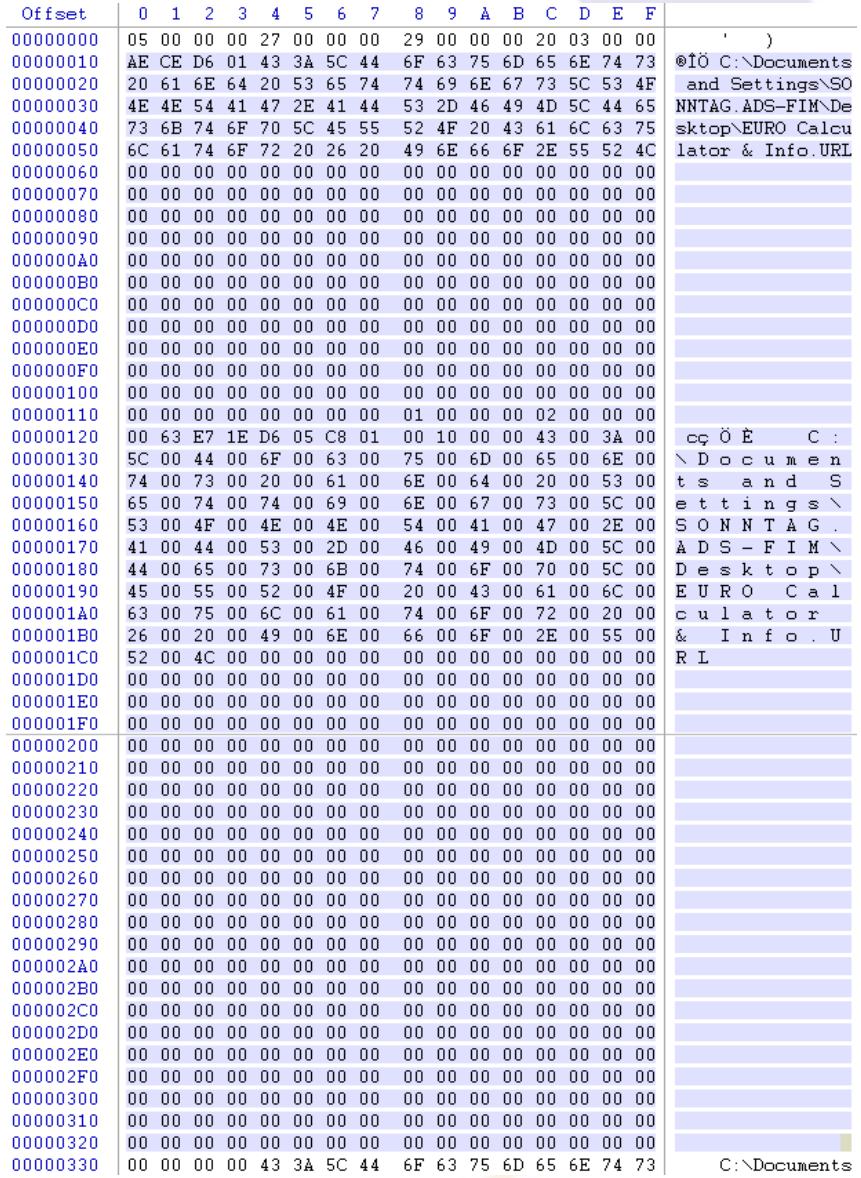
- Physical changes:
  - → File entry deleted from original directory
    - » Remains there until overwritten!
  - → Modified/Last Access updated
  - → The long filename is deleted
  - → File entry created in recycler directory
    - » D<original drive letter><#>.<original extension>
      - – Dc1.txt: Second deleted file from drive C, was *.txt
      - – Note: In the Windows Explorer you always see only your own files and the filenames from the INFO file!
    - » Subdirectory: User-SID
  - → Information added to recycler index file ("INFO"/"INFO2" file)
    - » Includes deletion time, original location, recycle bin index
      - – Index allows discovery of deletion order
    - » Attention: Windows Vista has replaced the INFO file with a separate file named similar as the one with the deleted data!

Windows forensic: Recycle bin

- The INFO2 file structure
  - → Binary file
  - → Contains the file name twice: ASCII and Unicode
  - → 20 Byte file header; Bytes 12-13 (-15?) are record size
    - » Record size is usually 2003 = 0x0320 = 800 Bytes
- Record structure
  - → 260 Bytes: Original file name (ASCII), including path
  - → 4 Bytes: Record number (0-???)
  - → 4 Bytes: Drive number (00 = A, 01 = B, 02 = C, …)
  - → 8 Bytes: Deletion time (FILETIME format, UTC)
  - → 4 Bytes: Physical file size (=Bytes on disk!)
  - → 520 Bytes: Original file name (Unicode), including path

Windows forensic: Recycle bin

- Original filename: C:\Documents and Settings\SONNTAG.ADS-FIM\Desktop\EURO Calculator & Info.URL
- Record number: 1
- Drive number: 2 (= C:)
- Deletion time: 0063E71E:D605C801 (=1EE76300:01C805D6, =3.10.2007 15:56:49)
- Physical file size: 0x00100000 (=0x00001000, = 4096 Bytes



Offset	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
00000000	05	00	00	00	27	00	00	00	29	00	00	00	20	03	00	00	')
00000010	AE	CE	D6	01	43	3A	5C	44	6F	63	75	6D	65	6E	74	73	®ÎÖ C:\Documents
00000020	20	61	6E	64	20	53	65	74	74	69	6E	67	73	5C	53	4F	and Settings\SO
00000030	4E	4E	54	41	47	2E	41	44	53	2D	46	49	4D	5C	44	65	NNTAG.ADS-FIM\De
00000040	73	6B	74	6F	70	5C	45	55	52	4F	20	43	61	6C	63	75	sktop\EURO Calcu
00000050	6C	61	74	6F	72	20	26	20	49	6E	66	6F	2E	55	52	4C	lator & Info.URL
00000060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000080	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000000F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000100	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000110	00	00	00	00	00	00	00	00	01	00	00	00	02	00	00	00	
00000120	00	63	E7	1E	D6	05	C8	01	00	10	00	00	43	00	3A	00	cç Ö È C :
00000130	5C	00	44	00	6F	00	63	00	75	00	6D	00	65	00	6E	00	\ D o c u m e n
00000140	74	00	73	00	20	00	61	00	6E	00	64	00	20	00	53	00	t s a n d S
00000150	65	00	74	00	74	00	69	00	6E	00	67	00	73	00	5C	00	e t t i n g s \
00000160	53	00	4F	00	4E	00	4E	00	54	00	41	00	47	00	2E	00	S O N N T A G .
00000170	41	00	44	00	53	00	2D	00	46	00	49	00	4D	00	5C	00	A D S - F I M \
00000180	44	00	65	00	73	00	6B	00	74	00	6F	00	70	00	5C	00	D e s k t o p \
00000190	45	00	55	00	52	00	4F	00	20	00	43	00	61	00	6C	00	E U R O C a l
000001A0	63	00	75	00	6C	00	61	00	74	00	6F	00	72	00	20	00	c u l a t o r
000001B0	26	00	20	00	49	00	6E	00	66	00	6F	00	2E	00	55	00	& I n f o . U
000001C0	52	00	4C	00	00	00	00	00	00	00	00	00	00	00	00	00	R L
000001D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000001E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000001F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000200	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000210	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000220	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000230	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000240	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000250	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000260	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000270	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000280	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000290	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
000002F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000300	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000310	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000320	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
00000330	00	00	00	00	43	3A	5C	44	6F	63	75	6D	65	6E	74	73	C:\Documents

Print spool files

- When printing documents, these are not immediately sent to the printer, but rather stored in a local file
  - → This is then sent to the printer
  - → Attention: Users can configure within the printer properties that the data is sent immediately to the printer; this is rare!
  - → Note this applies to local printers only!
    - » Network printers will have the file created on the server
- Typical file formats for spooling are:
  - → RAW: Directly as the printer wants it, e.g. Postscript or some proprietary format
    - » Device dependent
    - » Can be re-printed simply by sending to a (similar!) printer again
  - → EMF: Enhanced Metafile Format (32 Bit version of WMF)
    - » Device independent
    - » Viewer programs available

Print spool files

- For each print job two files are created
  - → SHD: Job metadata (owner, printer, print method, …)
  - → SPL: Job data (RAW or EMF)
- Contents of the SHD file:
  - → Username, Name of user to notify
  - → Document name
  - → Printing time
    - » SYSTEMTIME structure (=UTC!)
  - → Page count
  - → Windows version
  - → Job ID
  - → Priority
  - → Printer name + driver + mode
  - → Printing processor + format
  - → Computer name

Thumbs.db

- Thumbs.db: Hidden file to store thumbnail images (previews) of the files in a folder
  - → But ONLY, if the folder was viewed in "Thumbnail" viewed at SOME time in the past when the file was already there
  - → Can be deactivated (Default: enabled) in Explorer properties
    - » "Do not cache thumbnails"
  - → Deleting images from the disk will not remove the thumbnail from Thumbs.db!
    - » They will never be removed!
      - – Only solution: Delete Thumbs.db file!
- File format: OLE2 Compound Document (MS Office)
- What is stored: JPEG, BMP, GIF, HTM
- Encrypted files will still have an unencrypted thumbnail!
  - → However, this security flaw was fixed at some time

Thumbs.db

- Attention:
  - → Windows Vista does no longer have this file
    - » The data is now within the user profile folder: Application Data/Microsoft Internet Explorer/Thumbscache32
  - → Win2K+NTFS: Thumbnails in ADS (FAT → Thumbs.db!)
- Before Windows XP: Contained also drive letter and path
  - → Windows ME, Win2K
- Take care when copying directories to a USB stick:
  - → When copying the directory, the Thumbs.db file is copied too
  - → When copying all files, it is not copied (unless shown anyway)
- Thumbs.db can be used to prove that images actually were on a certain computer: The Thumbs.db file is still there, and the files (including the same Thumbs.db) have been found somewhere else!

Windows prefetch

- Frequently (or recently) used applications are logged in a special folder: Speed up their start by noting, which sectors from the disk will be required directly upon start
  - → These are then swapped in immediately, even if not at the beginning of the executable file
- Stored in directory "C:\Windows\Prefetch"
  - → Naming: <Executable file name>-XXXXXXX.pf
    - » XXXXX: Hash of location from where it was run
  - → Count of executing the program: Software\Microsoft\Windows\CurrentVersion\Explorer\UserAssist\{GUID}\Count
    - » ROT-13 encoded!
    - » "Data": 5th byte -5 = Count of execution
  - → Maximum count (XP): 128 entries
  - → Contains also references to loaded modules

Windows prefetch

- XP: Boot time and application launch, 2003: Boot time (def.)
- Attention: Prefetch is user-wide
  - → You cannot tell from the file, which user executed it
    - » But with MAC time this can be possible (if you know how was logged on at which time)
    - » See also the UserAssist registry entries (previous slide)
- Note the MAC times:
  - → Created: Program was started for the first time
  - → Modified: Program was started for the last time
    - » Attention: Will not be updated after some time (probably when windows decides it exactly knows what to do)
- .pf file content
  - → Timestamp: FILETIME at offset 0x78
  - → Run count: DWORD at offset 0x90

Disabling prefetch: http://msdn2.microsoft.com/en-us/library/ms940847.aspx

Swap/Paging file

- Contains pages from the memory
  - → Not necessarily in a "good" order!
  - → Data may remain there for a very long time as well
    - » If this sector happens to not being used
- Attention: Normal shutdown may delete, truncate, overwrite etc. the swap file!
  - → In real cases it is therefore important (after doing live analysis) to pull the plug, but not shutdown the system!
- Hidden file, C:\pagefile.sys
- Typical application for file carving: Assembling a file from numerous smaller parts
  - → Very difficult and unreliable, unless complete and in correct order (this is quite likely for small files)!
- Practical usage: Search for strings

Swap/Paging file

- Attention: Anything found in there is "suspect"!
  - → You don't know when this information was put in there
  - → You don't know which user was logged in at that time
  - → The data may have already been on the disk when the paging file was created
- The swap file need not be located in contiguous sectors
  - → There may be small "holes", which perhaps are not reused for a long time because they are so small

Hibernation file

- Similar to the swap file: Contains memory pages
  - → But here it is a complete image of the total memory!
  - → May be smaller or larger than the swap file
- Could theoretically be used to recreate the last point in time
  - → Virtual machine s might come in handy for this
- Hidden file: C:\Hiberfil.sys
- Attention: The first block will always be overwritten with zeros after boot, so never wake up a hibernated computer without obtaining a forensic copy before!
  - → Rest of the file remains unchanged until the next hibernation!
  - → So the state at a previous point in time may be recreated
- The hibernation file is actually compressed

The Windows Registry

- The Registry is similar to a file system:
  - → Hierarchical storage of data
  - → Keys = Directories
  - → Values = Files
    - » Name, Data and Type (BINARY, DWORD, SZ, MULTI_SZ, EXPAND_SZ)
- 5 root keys exist:
  - → HKLM: HKEY_LOCAL_MACHINE (Computer-specific data)
  - → HKU: HKEY_USERS (User-specific data)
  - → HKCR: HKEY_CLASSES_ROOT (per-user settings, file associations, class registrations for COM objects)
    - » Link to HKLM\Software\Classes
  - → HKCC: HKEY_CURRENT_CONFIG (Current hardware conf.)
    - » Link to HKLM\System\CurrentControlSet\Hardware Profiles\Current
  - → HKCU: HKEY_CURRENT_USER (Current user's data)
    - » Link to HKU\<SID of current user>

Physical storage of the registry

- The Registry is stored as a single file, i.e. a kind of volume
  - → But parts are stored in different files or created dynamically
- File locations:
  - → HKLM\SAM — %SYSTEMROOT%\System32\config\SAM
  - → HKLM\Security — %SYSTEMROOT%\System32\config\SECURITY
  - → HKLM\Software — %SYSTEMROOT%\System32\config\software
  - → HKLM\System — %SYSTEMROOT%\System32\config\system
  - → HKLM\Hardware — Stored in-memory only!
  - → HKU\.Default — %SYSTEMROOT%\System32\config\default
  - → HKU\SID — %USERPROFILE%\NTUSER.DAT
  - → HKU\SID_Classes — %USERPROFILE%\Local Settings\Application Data\Microsoft\Windows\UsrClass.dat

Windows forensic: Recent files MRU lists (Most Recently Used)

- These are usually stored within the registry
  - → Old windows versions: INI-files in windows or program direct.
- Common lists include:
  - → Start menu: HKCU
    Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs
    - » Equivalent of %USERPROFILE%\Recent
      ="My Recent Documents"
    - » Includes both local and network files!
  - → Run box: HKCU
    Software\Microsoft\Windows\CurrentVersion\Explorer\RunMRU
    - » In order of most recently added (not: used)!
  - → Files (Common dialog box): HKCU\Software
    Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSaveMRU
    Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedMRU
  - → Typed URLs in IE: HKCU
    Software\Microsoft\InternetExplorer\TypedURLs

Windows forensic: Recent files
MRU lists (Most Recently Used)

- → Windows default search: HKCU
  Software\Microsoft\SearchAssistant\ACMru
  - » Subkey 5603: Search terms for folders and filenames
  - » Subkey 5604: Search terms for words/phrases within files

- Note: MRU lists depend heavily on the
  - → Windows version
  - → Office version
  - → Installed patches
  - → Program configuration!
- Typically key names for other software are:
  - → Settings, MRU, Recent, Opened, …

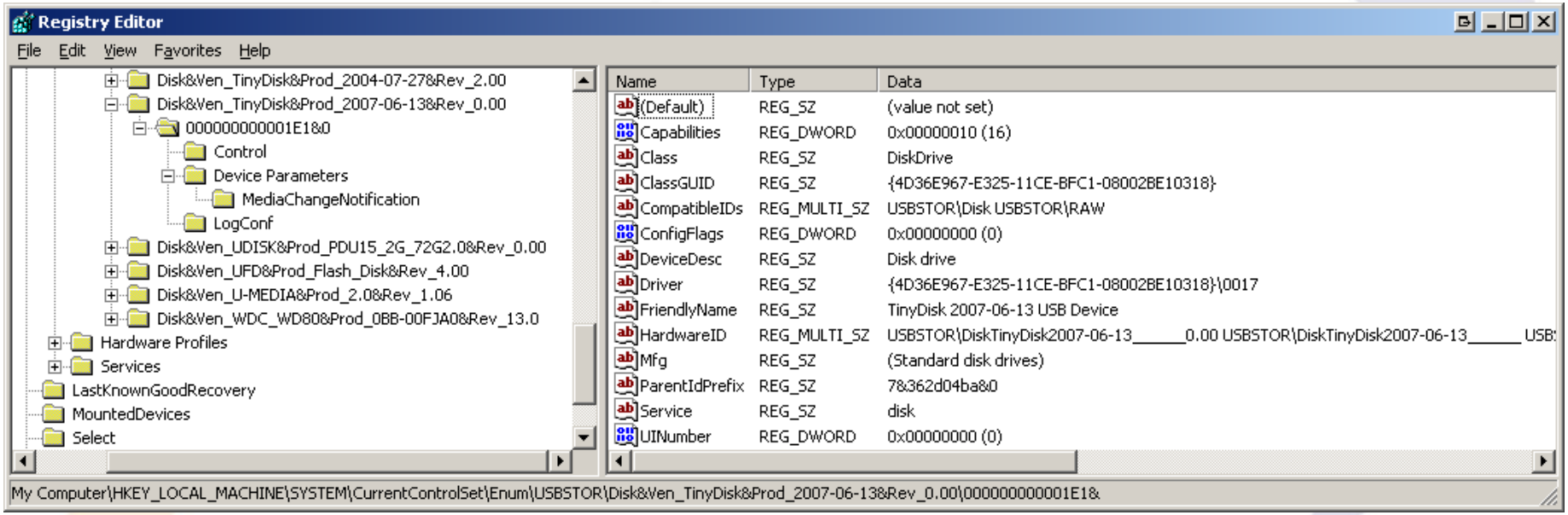
Windows forensic: Recent files

- Entries in "Recent", "Send to", "Start Menu", …
  - → Can prove the existence of files now deleted
    - » Note: Usually not produced on creating or copying files, but only on opening them!
  - → Especially useful for removable media, e.g. USB sticks
- Saved on the disk as ".LNK" files, i.e. shortcuts
- These contain a lot of information:
  - → File location
  - → Type of disk (hard disk, removable media, CD, …)
  - → File attributes, length, …
  - → Icon information
  - → MAC times
- May contain additional data
  - → Working directory, shell item ID, description, command line arguments, custom icon etc.

USB device history

- When a USB device is connected to a computer, this is "logged" within the registry
  - → I.e., configured and appropriate driver, if necessary, loaded
  - → This information remains when the device is disconnected!
- Note: Most USB storage device have serial numbers
  - → This means, the exact item can be recognized!
    - » Software: UVCView from Microsoft
- Registry key: HKLM\System\ControlSet00?\Enum\USBSTOR
  - → Subkey: Vendor, Producer and Revision
  - → Sub-Subkey: Serial number (if existing; else generated)
  - → ParentIdPrefix: Corresponds to HKLM\System\MountedDevices
    - » Binary value!
- In C:\Windows\setupapi.log the first installation is logged
- See also software: USBDeview!

USB device history



- Vendor: TinyDisk (Case label: "extreMEmory USB 2.0 4GB")
- Product: 2006-06-13, Rev. 0.00
- Serial number: 000000000001E1
- ParentIdPrefix: 7&362d04ba&0
  - → HKLM\System\MountedDevices: "\DosDevice\G:" \??\STORAGE#RemovableMedia#7&362d04ba&0&RM#{53f5630d-b6bf-11do-94f2-00a0c91efb8b}

USB device history: setupapi.log

[**2007/07/20 11:42:13 840.8 Driver Install**]
#-019 Searching for hardware ID(s): usbstor\disktinydisk2007-06-13_____0.00,usbstor\disktinydisk2007-06-13_____,usbstor\disktinydisk,usbstor\tinydisk2007-06-13_____0,tinydisk2007-06-13_____0,usbstor\gendisk,gendisk
#-018 Searching for compatible ID(s): usbstor\disk,usbstor\raw
#-198 Command line processed: C:\WINDOWS\system32\services.exe
#I022 Found "GenDisk" in C:\WINDOWS\inf\disk.inf; Device: "Disk drive"; Driver: "Disk drive"; Provider: "Microsoft"; Mfg: "(Standard disk drives)"; Section name: "disk_install".
#I023 Actual install section: [disk_install.NT]. Rank: 0x00000006. Effective driver date: 07/01/2001.
#-166 Device install function: DIF_SELECTBESTCOMPATDRV.
#I063 Selected driver installs from section [disk_install] in "c:\windows\inf\disk.inf".
#I320 Class GUID of device remains: {4D36E967-E325-11CE-BFC1-08002BE10318}.
#I060 Set selected driver.
#I058 Selected best compatible driver.
#-166 Device install function: DIF_INSTALLDEVICEFILES.
#I124 Doing copy-only install of "USBSTOR\DISK&VEN_TINYDISK&PROD_2007-06-13&REV_0.00\000000000001E1&0".
#-166 Device install function: DIF_REGISTER_COINSTALLERS.
#I056 Coinstallers registered.
#-166 Device install function: DIF_INSTALLINTERFACES.
#-011 Installing section [disk_install.NT.Interfaces] from "c:\windows\inf\disk.inf".
#I054 Interfaces installed.
#-166 Device install function: DIF_INSTALLDEVICE.
#I123 Doing full install of "USBSTOR\DISK&VEN_TINYDISK&PROD_2007-06-13&REV_0.00\000000000001E1&0".
#I121 Device install of "USBSTOR\DISK&VEN_TINYDISK&PROD_2007-06-13&REV_0.00\000000000001E1&0" finished successfully.

USB device history

- Last connection: HKLM\System\ControlSet00?\Control\DeviceClass
  - → Subkey "{53f56307-b6bf-11d0-94f2-00a0c91efb8b}": Disks
    - » Contains a subkey with the serial number included
  - → Subkey "{53f5630d-b6bf-11d0-94f2-00a0c91efb8b}": Volumes
    - » Contains a subkey with the ParentIdPrefix included
  - → The LastWrite Time of these keys is the date and time the device was last connected to the computer
- Accessing the LastWrite time:
  - → Special tools, or
  - → Regedt32: Export as text and open in Notepad
  - → Key Name: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\DeviceClasses\{53f56307-b6bf-11d0-94f2-00a0c91efb8b}\##?#USBSTOR#Disk&Ven_TinyDisk&Prod_2007-06-13&Rev_0.00#000000000001E1&0#{53f56307-b6bf-11d0-94f2-00a0c91efb8b}
  - → Class Name: <NO CLASS>
  - → Last Write Time: **21.12.2007 - 09:12**
  - → Value 0

Registry: Owner information

- Owner/Organization: HKLM\Software\Microsoft\Windows NT\CurrentVersion
  - → RegisteredOwner: Owner name
  - → RegisteredOrganization: Organization name
  - → ProductId: Product ID
  - → DigitalProductId: Contains the license key
    - » Encrypted; Bytes 52-66
  - → InstallDate: Installation date (UNIX timestamp)
  - → SystemRoot: Windows installation directory
- Last user:HKLM\Software\Microsoft\Windows NT\CurrentVersion\Winlogon
  - → DefaultUserName: Last logged in user
  - → DefaultDomainName: Last domain logged into
  - → DontDisplayLastUserName: Don't store information above

http://www.dagondesign.com/articles/windows-xp-product-key-recovery/
http://geekswithblogs.net/willemf/archive/2006/04/23/76125.aspx

Registry: Network shares

- "My Network Shares": List of shares within the LAN HKCU\Software\Microsoft\Windows\Current Version\Explorer\ComputerDescriptions
  - → Allows reconstruction of a past view, i.e. what shares were accessed by the user
  - → Contains computers, shares (directories) and printers
  - → Value: Name = server/share/printer; Content = Description

Registry: WLANs

- When accessing a WLAN, its SSID is stored:
  HKLM\Software\Microsoft\WZCSVC\Parameters\Interfaces
  - → Subkeys look like GUIDs with values for "ActiveSettings", "Static#000?", …
  - → The values for "#Static000?" contain the SSIDs at offset 0x14
- IP address information for this connection (last only):
  HKLM\System\ControlSet00?\Services\Tcpip\Parameters\Interfaces
  - → Look for the same "GUID" key as of the WLAN!
  - → Dhcp*: Data on DHCP server, assigned address, netmask, default gateway, domain, nameservers, …
  - → LeaseObtainedTime/-TerminatesTime: Unix 23 Bit Timestamp
    - » When the Address was received and what is the definite last time it could have been used (but not: **was** used!)

Registry: Various

- Every single registry key has a "LastWrite" time value
  - → Does **NOT** exist for registry values!
  - → Format: FILETIME
  - → Updated, when a registry value in the key is created, modified or deleted
- Win2K and WinXP registry editors are flawed
  - » Regedit.exe, regedt32.exe
  - → Registry values with a name length of 256-259 characters are not shown
    - » Values afterwards are suppressed as well
    - » Subkeys are not accessible too
  - → But "reg.exe", the console registry tool, can show (and manipulate) such values!

http://search.cpan.org/~adamk/Win32-TieRegistry-0.25/TieRegistry.pm

Registry: Various

- Shutting down a suspect's computer?
  - → First check: HKLM System\CurrentControlSet\Control\SessionManager\MemoryManagement\ClearPageFileAtShutdown
    - » Value "1": Paging file NOT deleted, but overwritten with zeros
- HKLM\System\CurrentControlSet\Control\FileSystem\NtfsDisableLastAccessUpdate
  - → Disables writing last access on the filesystem
    - » Will **still** be changed on file modifications (i.e. writing to it), but not on reading, accessing properties etc.!
- HKEY_CURRENT_USER\Software\Microsoft\Protected Storage System Provider
  - → Contains IE auto-complete passwords (encrypted)
  - → Content not directly accessible, not even with regedt32
  - → But can be read in live systems or in parsing the registry file

Registry: Substitute executed programs

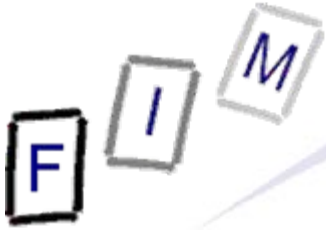
- Allows hiding what programs were ACTUALLY executed!
- HKLM\Software\Microsoft\Windows NT\CurrentVersion\Image File Execution Options
  - → Create subkey with name of executable, e.g. "calc.exe"
  - → Create string with name "Debugger" and value of alternate program, e.g. "C:\Windows\notepad.exe"
  - → Typing "calc.exe" will then start the editor
    - » With "calc" as parameter
    - » Or whatever the "original" file was, e.g. a .lnk file
  - → Shows only the "original" program in history lists!
- HKCR\{exe|com|bat}file\shell\open\command
  - → Default value contains command to execute ".exe" files
    - » Similar for the explorer context menu: HKCR\Drive\shell and HKCR\Folder\shell

Windows restore points

- Stored under C:\System Volume Information
  - → Not accessible through Explorer, but forensic tools!
    - » Not even for the administrator!
- By default created every 24 hours and retained for 90 days
    - » Registry: HKLM\Software\Microsoft\WindowsNT\CurrentVersion\SystemRestore
  - → Also: Manually, before Windows update, SW installation, …
  - → When reverting to a previous point, another restore point is created (to allow going "forward")
    - » Restoration is recorded in the system event log (Event ID 110)!
  - → Disabling them is possible
    - » Less than 200MB free on system drive → automatically disabled!
- Content:
  - → Files to restore (see change.log for original path/filename)
  - → Subfolder "snapshot": Registry files (SAM, Security, Software, System, .Default, NTUSER files, USRCLASS files)

Conclusions

- Especially the Registry is a treasure trove of information
  - → But the data is very well hidden under obscure names
  - → Special attention needs to be paid to how reliable the data is
    - » Windows version, source of description of keys/values etc.!
  - → Restore points contain previous versions of the registry
- Remnants of activity remain may on the computer for a long time: Recycle bin records, print spool files, …
  - → Sometimes even forever (Thumbs.db) unless expl. removed!
- Restricting the investigation is therefore very desirable
  - → Only a subset of data need then be searched for/through!



Questions?

Thank you for your attention!

Links

- Windows Recycle Bin:
  http://www.foundstone.com/us/resources/proddesc/rifiuti.htm
- MRU locations:
  http://windowsxp.mvps.org/RegistryMRU.htm
- Windows Spool Files
  http://www.undocprint.org/winspool/spool_files
- Hurlbut, D.: Thumbs DB File Forensic Issues
  http://www.accessdata.com/media/en_US/print/papers/wp.Thumbs_DB_Files.en_us.pdf
- USBDeview
  http://www.nirsoft.net/utils/usb_devices_view.html
- System Restore Point Log Decoding
  http://www.ediscovery.co.nz/wip/srp.html