catch me, if you can…

james c. foster & vinnie liu

blackhat briefings 2005

speaker bios

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411

- ***avoid detection***
  - *top ten weaknesses in current forensic techniques*
- ***break industry tools***
  - *NTFS, MS ISA Server, CA eTrustAudit, eEye Blink, PGP Desktop, Guidance EnCase, MS AntiSpyware*
- ***Metasploit Anti-Forensic Investigation Arsenal***
  - *timestomp, slacker, transmogrify, sam juicer*
- ***identify opportunities for improvement***

isn’t this bad?

- *it’s an opportunity to fix some serious problems.*
- *the lack of true innovation in the forensics world is because there’s no pressure to do so.*
- *not creating vulnerabilities, just identifying them.*
- *too much dependence on forensic tools.*

format

- *technique*
- *anti-technique*
- *opportunity for improvement*
- *anything else (vulns, weaknesses, tools, etc…)*

we’re not geniuses

- *we’ve found ways to leverage weaknesses in NTFS in regards to the forensic community*

temporal locality

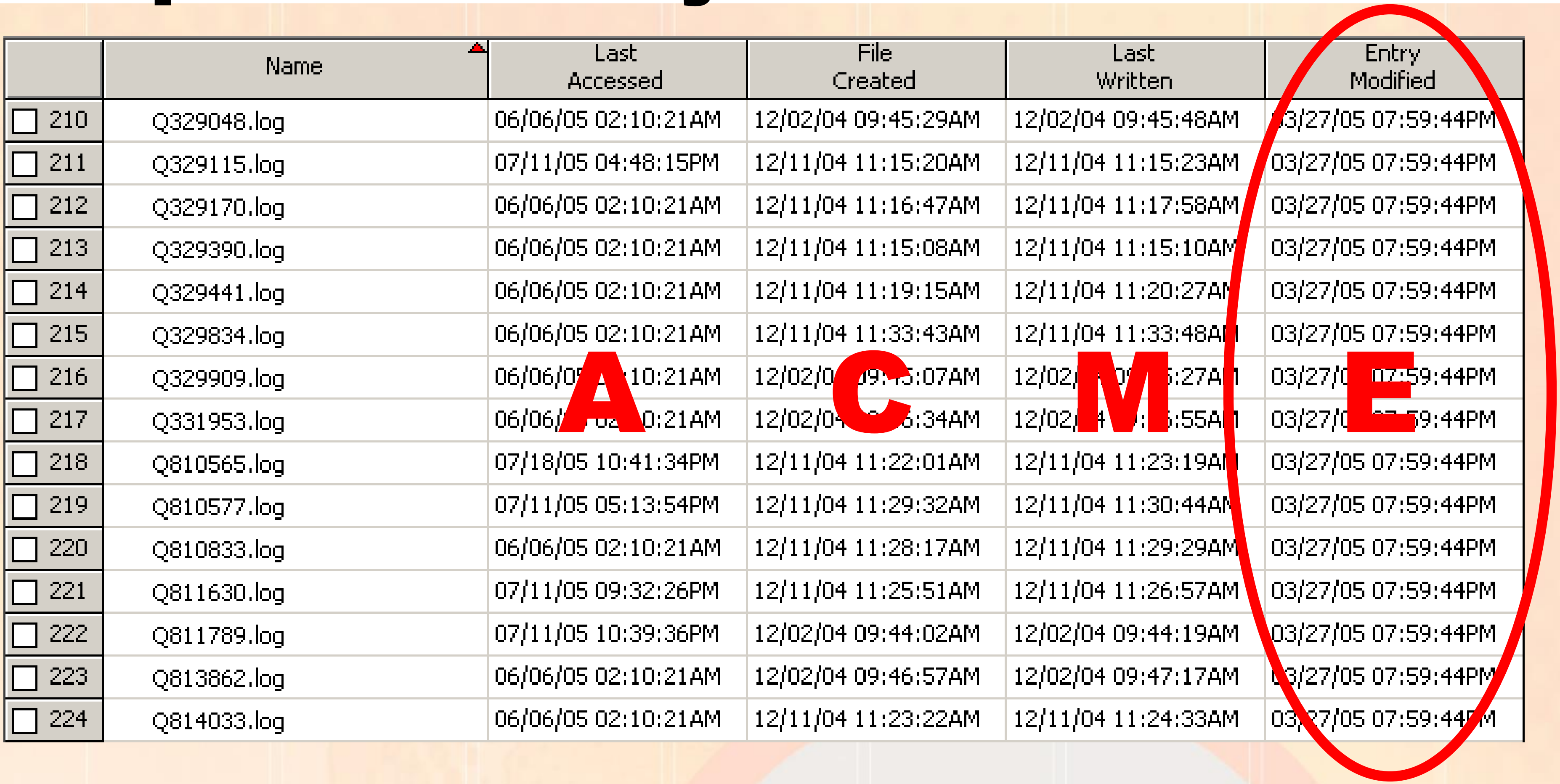
- *technique*
  - *timestamps are important because they provide clues as to when an event occurred.*
  - *timestamps allow an analyst in timelining events and profiling hacker behavior.*
  - *if an investigator finds a suspicious file, they will search for other files with similar MAC attributes.*

temporal locality

- *anti-technique*
  - *modify file times, log file entries, and create bogus and misleading timestamps*

- *we need better tools…*
  - *most tools are like Logz (BH Windows 2004, Foster)*
  - *only modify the MAC*
  - *fine for FAT, but not for NTFS…*

temporal locality



	Name	Last Accessed	File Created	Last Written	Entry Modified
□ 210	Q329048.log	06/06/05 02:10:21AM	12/02/04 09:45:29AM	12/02/04 09:45:48AM	03/27/05 07:59:44PM
□ 211	Q329115.log	07/11/05 04:48:15PM	12/11/04 11:15:20AM	12/11/04 11:15:23AM	03/27/05 07:59:44PM
□ 212	Q329170.log	06/06/05 02:10:21AM	12/11/04 11:16:47AM	12/11/04 11:17:58AM	03/27/05 07:59:44PM
□ 213	Q329390.log	06/06/05 02:10:21AM	12/11/04 11:15:08AM	12/11/04 11:15:10AM	03/27/05 07:59:44PM
□ 214	Q329441.log	06/06/05 02:10:21AM	12/11/04 11:19:15AM	12/11/04 11:20:27AM	03/27/05 07:59:44PM
□ 215	Q329834.log	06/06/05 02:10:21AM	12/11/04 11:33:43AM	12/11/04 11:33:48AM	03/27/05 07:59:44PM
□ 216	Q329909.log	06/06/05 [illegible]10:21AM	12/02/0[illegible]9:[illegible]5:07AM	12/02/[illegible]5:27AM	03/27/0[illegible]7:59:44PM
□ 217	Q331953.log	06/06/[illegible]0:21AM	12/02/04[illegible]6:34AM	12/02/[illegible]5:55AM	03/27/0[illegible]9:44PM
□ 218	Q810565.log	07/18/05 10:41:34PM	12/11/04 11:22:01AM	12/11/04 11:23:19AM	03/27/05 07:59:44PM
□ 219	Q810577.log	07/11/05 05:13:54PM	12/11/04 11:29:32AM	12/11/04 11:30:44AM	03/27/05 07:59:44PM
□ 220	Q810833.log	06/06/05 02:10:21AM	12/11/04 11:28:17AM	12/11/04 11:29:29AM	03/27/05 07:59:44PM
□ 221	Q811630.log	07/11/05 09:32:26PM	12/11/04 11:25:51AM	12/11/04 11:26:57AM	03/27/05 07:59:44PM
□ 222	Q811789.log	07/11/05 10:39:36PM	12/02/04 09:44:02AM	12/02/04 09:44:19AM	03/27/05 07:59:44PM
□ 223	Q813862.log	06/06/05 02:10:21AM	12/02/04 09:46:57AM	12/02/04 09:47:17AM	03/27/05 07:59:44PM
□ 224	Q814033.log	06/06/05 02:10:21AM	12/11/04 11:23:22AM	12/11/04 11:24:33AM	03/27/05 07:59:44PM

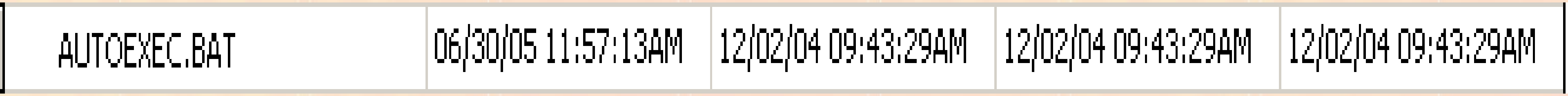
- *modified (**M**), accessed (**A**), created (**C**)*
- *entry modified (E)*

we have the technology...

- ***timestomp***
  - *uses the following Windows system calls:*
    - *NtQueryInformationFile()*
    - *NtSetInformationFile()*
  - *features:*
    - *display current MACE attributes*
    - *set MACE attributes*
    - *mess with **EnCase** and **MS Anti-Spyware***

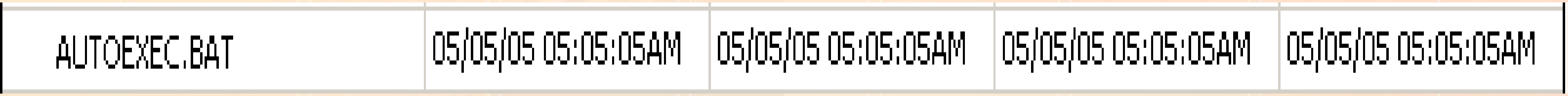
timestomp doing its thing

- ***normal***



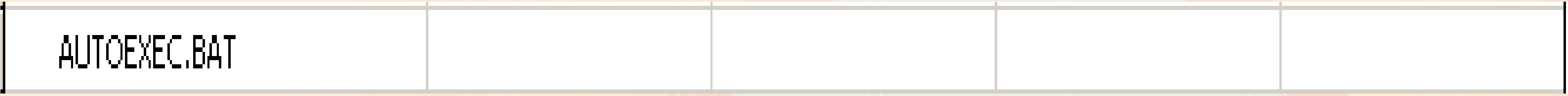
AUTOEXEC.BAT	06/30/05 11:57:13AM	12/02/04 09:43:29AM	12/02/04 09:43:29AM	12/02/04 09:43:29AM

- ***after setting values*** ***(-z “Monday 05/05/2005 05:05:05 AM”)***



AUTOEXEC.BAT	05/05/05 05:05:05AM	05/05/05 05:05:05AM	05/05/05 05:05:05AM	05/05/05 05:05:05AM

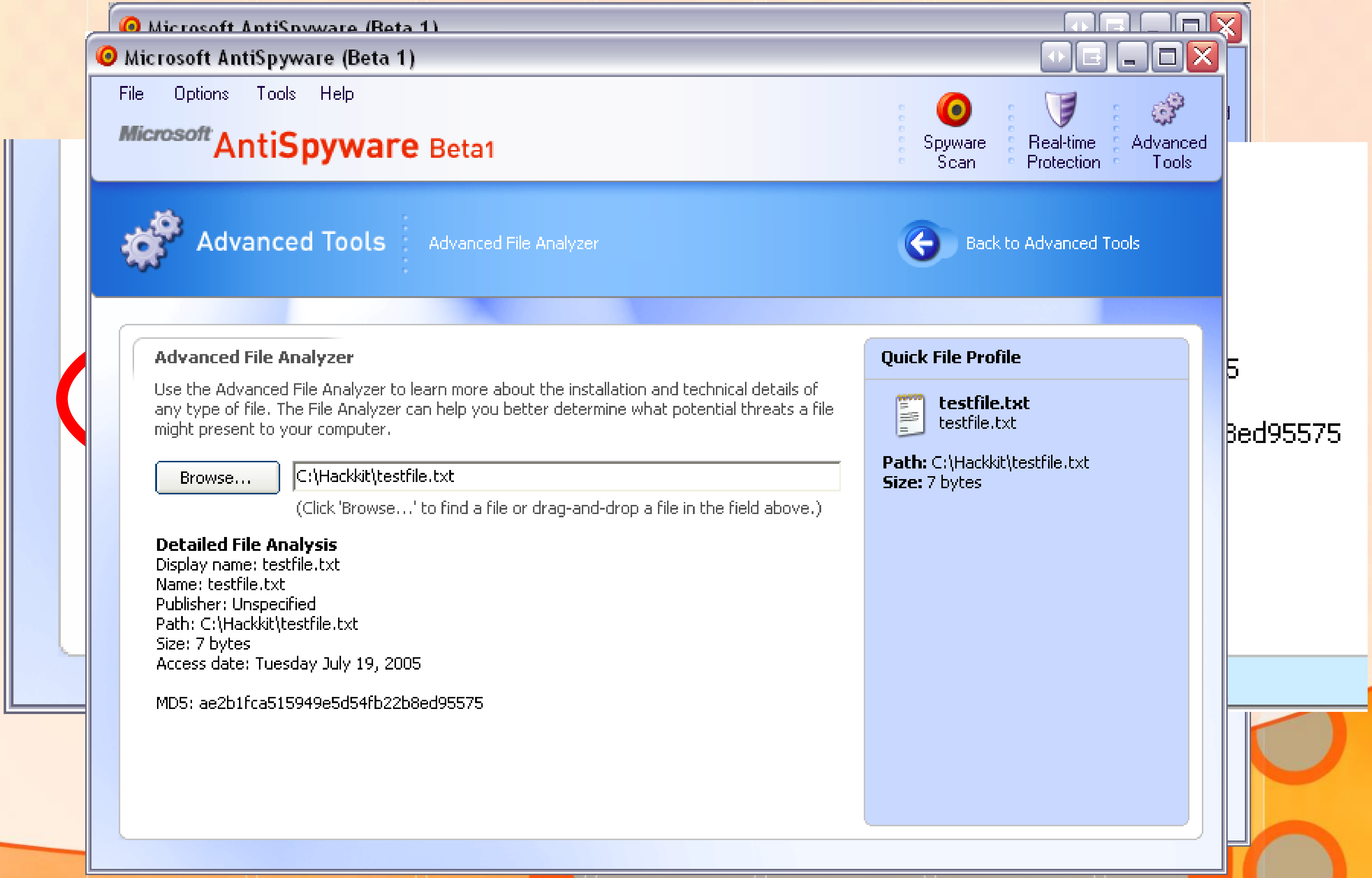
- ***example EnCase weakness*** ***(-b)***



AUTOEXEC.BAT				

- ***what if (-R)?***
  - ***bye bye timestamps***

timestomp doing its thing



Advanced File Analyzer

Use the Advanced File Analyzer to learn more about the installation and technical details of any type of file. The File Analyzer can help you better determine what potential threats a file might present to your computer.

C:\Hackkit\testfile.txt

(Click 'Browse...' to find a file or drag-and-drop a file in the field above.)

Detailed File Analysis
Display name: testfile.txt
Name: testfile.txt
Publisher: Unspecified
Path: C:\Hackkit\testfile.txt
Size: 7 bytes
Access date: Tuesday July 19, 2005

MD5: ae2b1fca515949e5d54fb22b8ed95575

Quick File Profile

testfile.txt
testfile.txt

Path: C:\Hackkit\testfile.txt
Size: 7 bytes

one opportunity for improvement

- *current state*
  - *EnCase only uses the MACE values from the Standard Information Attribute (SIA) in a each file's MFT record*

MFT Entry Header	**SIA Attribute** **MACE**	**FN Attribute** **MACE**	**Remaining Attributes…**

- *opportunity for improvement*
  - *validate SIA MACE values with the MACE values stored in the Filename (FN) attribute*

one opportunity for improvement

- *given*
  - *the FN MACE values are only updated when a file is created or moved*
- *therefore*
  - *FN MACE values must be older than SIA MACE values*
- *validation technique*
  - *determine if the SIA MACE values are older than the FN MACE values*

…more like one-half

- *anti-validation technique*
  - *calculate offsets from the start of the MFT to a file's FN MACE values*
  - *use raw disk i/o to change the FN MACE values*
  - *use a file that's not been used in a while, delete the $data attribute and fill it with your own data*

- *timestomp*
  - *its definitely dicey to perform live changes to the MFT, but look for it in future versions*

more goodies...

- *weaknesses in what?*
  - *all computer logging applications*

- *think STICK for logging systems*
  - *specifically: CA e-Trust Suite has issues reading numerous types of log file, especially if they have been modified*

***Hopefully new STICK-like host-based anti-forensics tool to be released at BlackHat Japan 2005!*

logging weaknesses

vuln #1

- *technique*
  - *text-based signature analysis similar to clear-text AV dat files or dictionary word searches*

- *anti-technique and vulnerability #1*
  - *breaking logfile signature analysis engines for host-based tools*
  - *weakness in CA e-Trust Audit!*
  - *adding binary data to a text-based log file*
  - *overrunning log limits remotely with known logging techniques*
  - *HINT: USE SPECIAL NON-ASCII CHARACTERS*

fooling MSFT logging techniques

- *anti-techniques continued*
  - *leveraging Windows system calls and logging schemes that are default-enabled in MSFT*
    - *Ex: MsiInstaller Event (11707)*

DoS

- *technique*
  - *analyze log files in real-time streams to identify and correlate any suspicious events*
  - *most analysis engines utilize a regular expression engine*

- *anti-technique*
  - *flood the system with log file entries*
  - *EMBED REGULAR EXPRESSIONS INTO LOG FILE ENTRIES*

- *weakness*
  - *CPU RESOURCE UTILIZATION BUG will hang the system in internal looping construct*

spatial locality

- *technique*
  - *attackers tend to store tools in the same directory*
- *anti-technique*
  - *stop using %windir%\system32*
  - *mix up storage locations both on a host and between multiple hosts*
  - *3rd party software, MS ClipArt, browser temp, MS CAB files, anti-virus/anti-spam/spyware*

data recovery

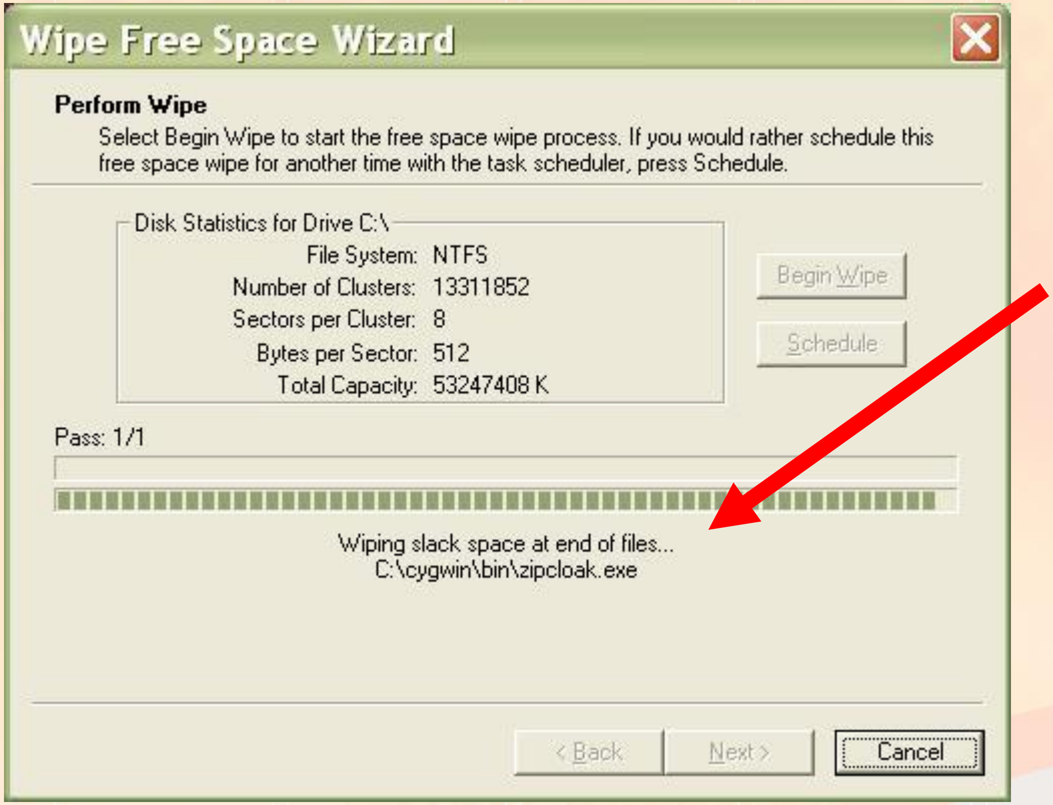
- *technique*
  - *forensics tools will make a best effort to reconstruct deleted data*
- *anti-technique*
  - *secure file deletion*
    - *filename, file data, MFT record entry*
  - *wipe all slackspace*
  - *wipe all unallocated space*

data recovery

- *tools*
  - *Sys Internals – sdelete.exe – not file slack space*
  - *Eraser (heide) – file slack space*
  - *PGP Desktop’s utilities*

- *vulnerabilities*
  - *PGP Desktop’s utilities*

selling snake oil



Wipe Free Space Wizard

Perform Wipe

Select Begin Wipe to start the free space wipe process. If you would rather schedule this free space wipe for another time with the task scheduler, press Schedule.

Disk Statistics for Drive C:\

```
      File System:  NTFS
Number of Clusters:  13311852
Sectors per Cluster:  8
  Bytes per Sector:  512
    Total Capacity:  53247408 K
```

Pass: 1/1

Wiping slack space at end of files...
C:\cygwin\bin\zipcloak.exe

PGP 8.x and 9.1 - "wiping slack space at end of files…"

well, it doesn't.

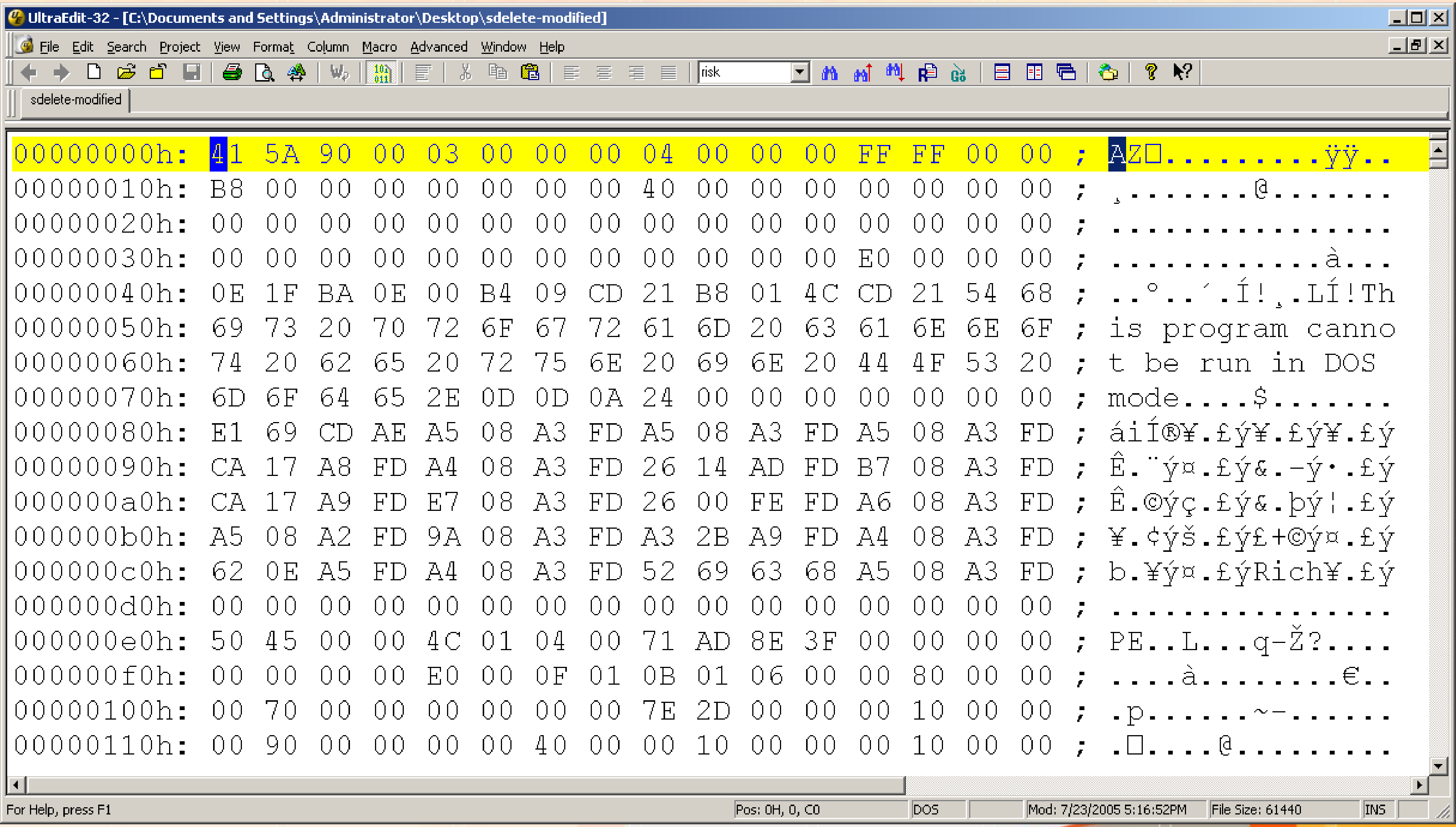
think of it as an opportunity for improvement…

signature analysis

- *technique*
  - *EnCase has two methods for identifying file types*
    - *file extension*
    - *file signatures*

- *anti-technique*
  - *change the file extension*
    - ***Special note – this lame technique will also work on nearly every perimeter-based file sweeping product (prime ex: gmail)*
  - *changing file signatures to avoid EnCase analysis*
    - *one-byte modification*

fooling signature analysis

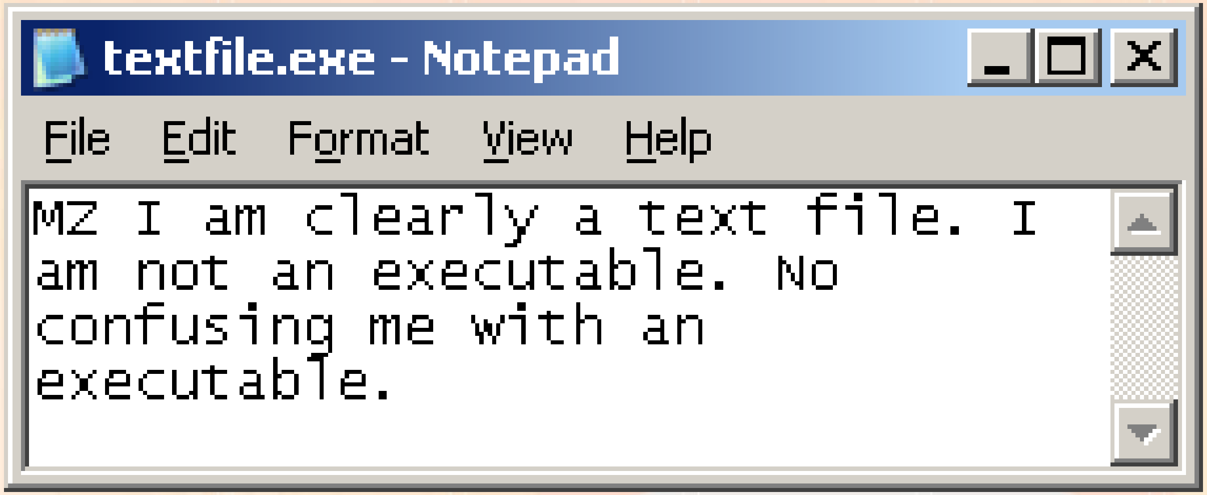

UltraEdit-32 - [C:\Documents and Settings\Administrator\Desktop\sdelete-modified]
File Edit Search Project View Format Column Macro Advanced Window Help
risk
sdelete-modified

```
00000000h: 41 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00 ; AZ□.........ÿÿ..
00000010h: B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00 ; ¸.......@.......
00000020h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................
00000030h: 00 00 00 00 00 00 00 00 00 00 00 00 E0 00 00 00 ; ............à...
00000040h: 0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68 ; ..º..´.Í!¸.LÍ!Th
00000050h: 69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F ; is program canno
00000060h: 74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20 ; t be run in DOS 
00000070h: 6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00 ; mode....$.......
00000080h: E1 69 CD AE A5 08 A3 FD A5 08 A3 FD A5 08 A3 FD ; áiÍ®¥.£ý¥.£ý¥.£ý
00000090h: CA 17 A8 FD A4 08 A3 FD 26 14 AD FD B7 08 A3 FD ; Ê.¨ý¤.£ý&.-ý·.£ý
000000a0h: CA 17 A9 FD E7 08 A3 FD 26 00 FE FD A6 08 A3 FD ; Ê.©ýç.£ý&.þý¦.£ý
000000b0h: A5 08 A2 FD 9A 08 A3 FD A3 2B A9 FD A4 08 A3 FD ; ¥.¢ýš.£ý£+©ý¤.£ý
000000c0h: 62 0E A5 FD A4 08 A3 FD 52 69 63 68 A5 08 A3 FD ; b.¥ý¤.£ýRich¥.£ý
000000d0h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ; ................
000000e0h: 50 45 00 00 4C 01 04 00 71 AD 8E 3F 00 00 00 00 ; PE..L...q-Ž?....
000000f0h: 00 00 00 00 E0 00 0F 01 0B 01 06 00 00 80 00 00 ; ....à........€..
00000100h: 00 70 00 00 00 00 00 00 7E 2D 00 00 00 10 00 00 ; .p......~-......
00000110h: 00 90 00 00 00 00 40 00 00 10 00 00 00 10 00 00 ; .□....@.........
```

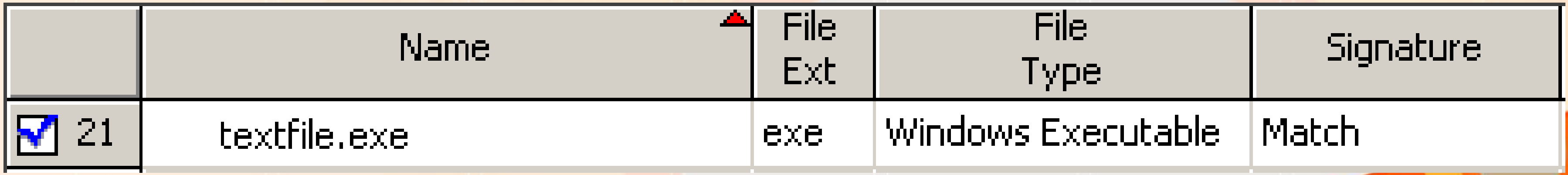
For Help, press F1 | Pos: 0H, 0, C0 | DOS | Mod: 7/23/2005 5:16:52PM | File Size: 61440 | INS

...and again

- *tools*
  - ***transmogrify***
    - *does all the work for you*



```
MZ I am clearly a text file. I
am not an executable. No
confusing me with an
executable.
```



	Name	File Ext	File Type	Signature
☑ 21	textfile.exe	exe	Windows Executable	Match

tricking the software

- *technique*
  - *select text-based logs to analyze*
- *anti-technique*
  - *modify all text-based logs to executables or dlls and now the entire logging system is broken*
  - *the system will hang and not be able to override internal controls to analyze the files*

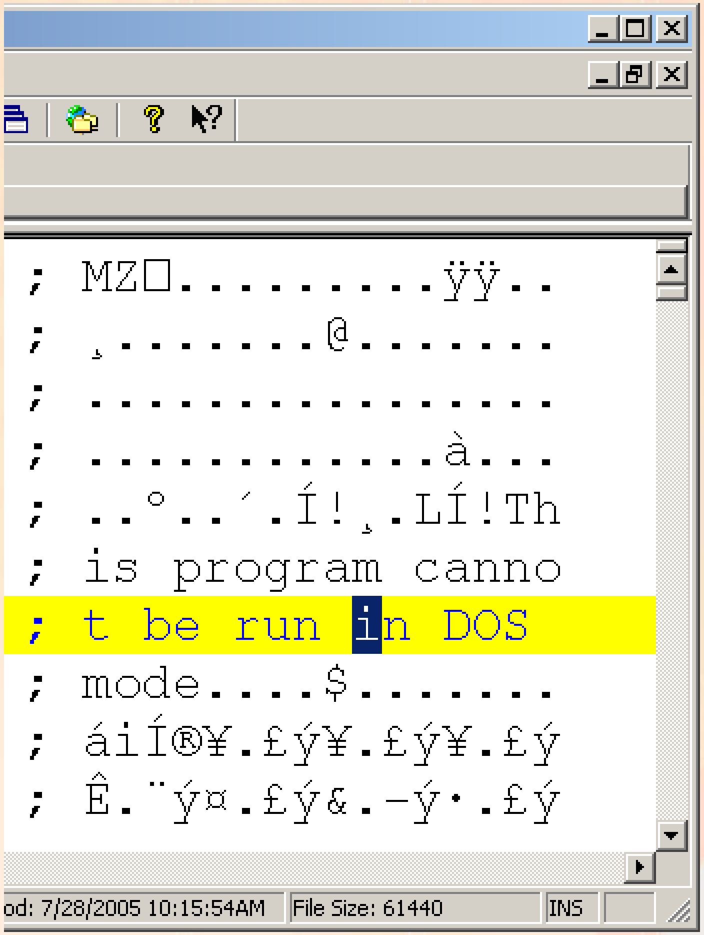
hashing

- *technique*
  - *create an MD5 fingerprint of all files on a system*
  - *compare to lists of **known good** & **known bad** file hashes*
  - *minimizes search scope and analysis time*

- *anti-technique*
  - *avoid common system directories (see earlier)*
  - *modify and recompile*
    - *remove usage information*
  - *stego works too*
  - *direct binary modification*

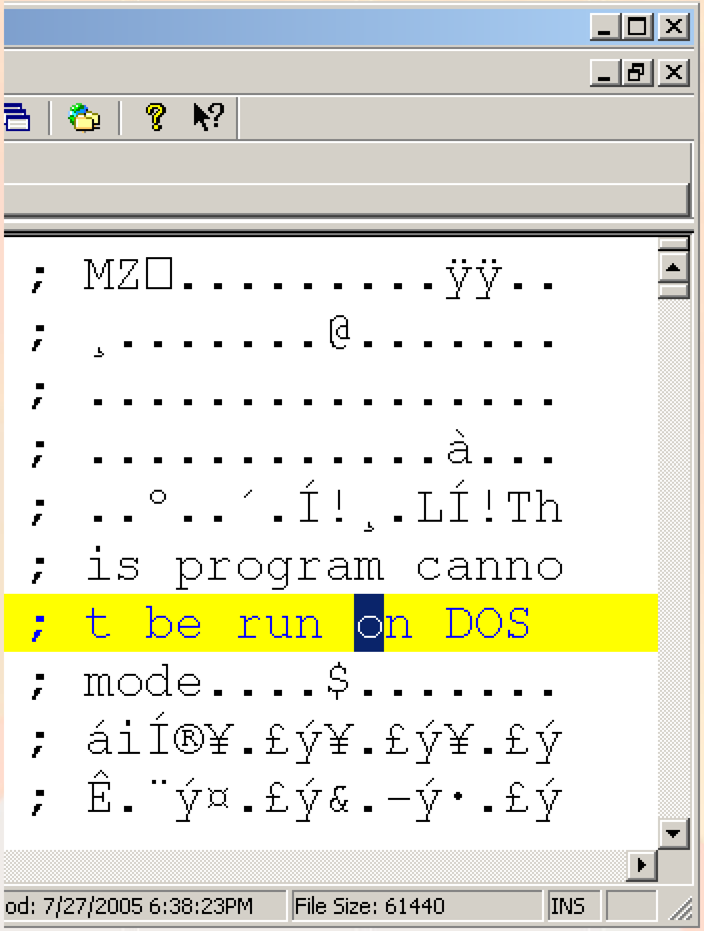
hashing

- *direct binary modification (one-byte)*



```
; MZ□.........ÿÿ..
; ¸.......@.......
; ................
; ............à...
; ..º..´.Í!¸.LÍ!Th
; is program canno
; t be run in DOS
; mode....$.......
; áiÍ®¥.£ý¥.£ý¥.£ý
; Ê.¨ý¤.£ý&.–ý•.£ý
```

od: 7/28/2005 10:15:54AM | File Size: 61440 | INS



```
; MZ□.........ÿÿ..
; ¸.......@.......
; ................
; ............à...
; ..º..´.Í!¸.LÍ!Th
; is program canno
; t be run on DOS
; mode....$.......
; áiÍ®¥.£ý¥.£ý¥.£ý
; Ê.¨ý¤.£ý&.–ý•.£ý
```

od: 7/27/2005 6:38:23PM | File Size: 61440 | INS

4e65745d42c70ac0a5f697e22b8bb033
eafcc942c7960f921c64c1682792923c

keyword searching

- *technique*
  - *analysts build lists of keywords and search through files, slack space, unallocated space, and memory*
- *anti-technique*
  - *exploit the examiner’s lack of language skill*
  - *great and nearly impossible to catch*
- *opportunity for improvement*
  - *predefined keyword lists in different languages*

reverse engineering

- *technique*
  - *most examiners have only very rudimentary malware analysis skills: PEiD + UPX + BinText*
  - *behavioral analysis*
- *anti-technique*
  - *packers prevents strings technique*
  - *create a custom loader (PE Compact 2)*
  - *there is a strategy to packing*

profiling

- *technique*
  - *analysts find commonalities between: tools, toolkits, packers, language, location, timestamps, usage info, etc…*
- *anti-technique*
  - *use what's already in your environment*

information overload

- *technique*
  - *forensics takes time, and time costs money*
  - *businesses must make business decisions, that means money has influence*
  - *no pulling-the-plug. business data takes priority.*

- *anti-technique*
  - *on a multi-system compromise, make the investigation cost as much as possible*
  - *choose the largest drive*
  - *help the investigators*

hiding in memory

- *technique*
  - *EnCase Enterprise allows the examiner to see current processes, open ports, file system, etc…*
- *anti-technique*
  - *Metasploit's Meterpreter (never hit disk)*
  - *exploit a running process and create threads*
- *opportunity for improvement*
  - *capture what's in memory*
  - *combine encase with non-traditional forensic tools such as IPS*
- *NOTE: Anti-virus and host-based IPS will/should catch memory active and resident tools and threads*

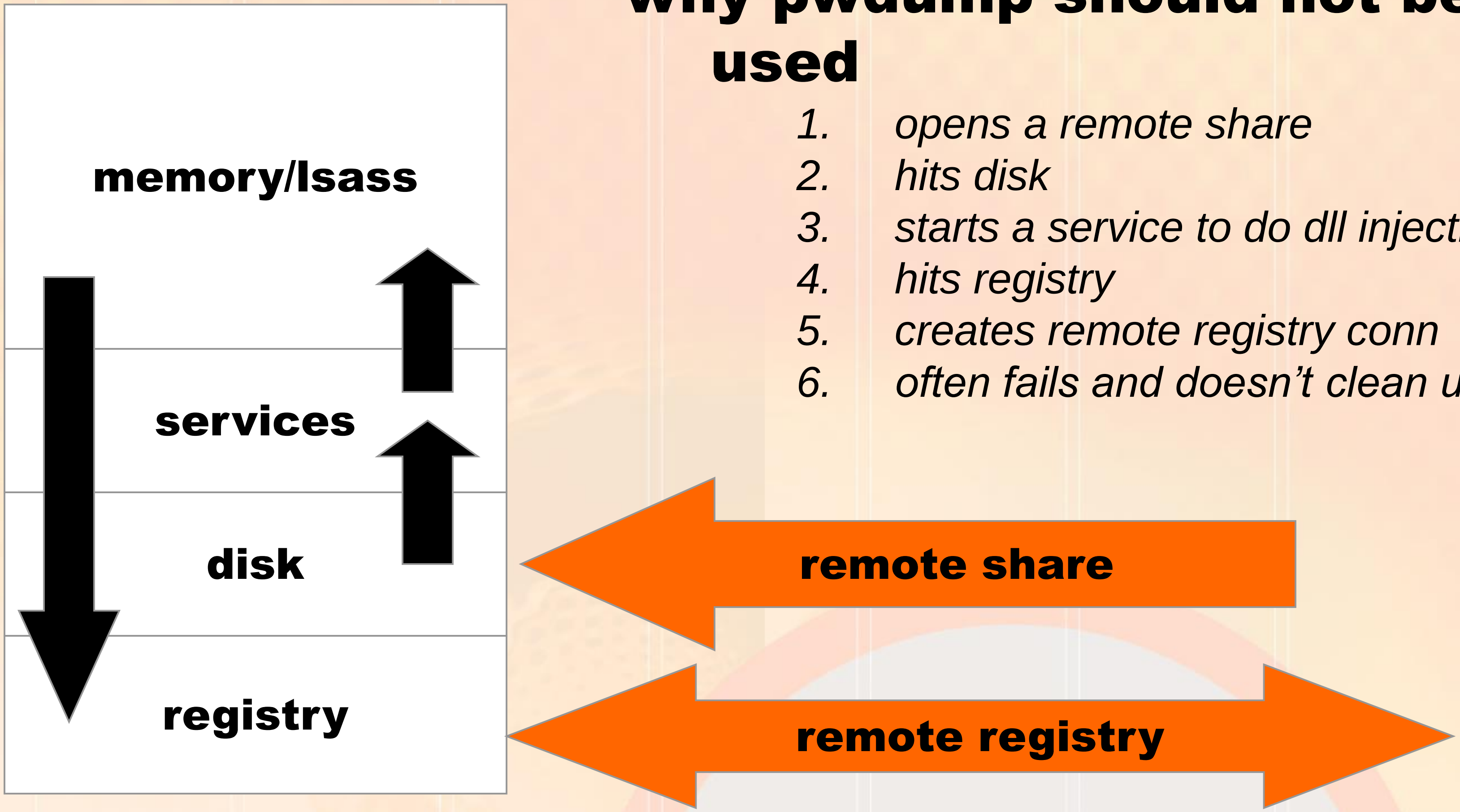
hiding in memory

- *tools*
  - ***sam juicer***
    - *think: pwdump on crack*
    - *built from the ground up*
    - *stealthy!*

hiding in memory

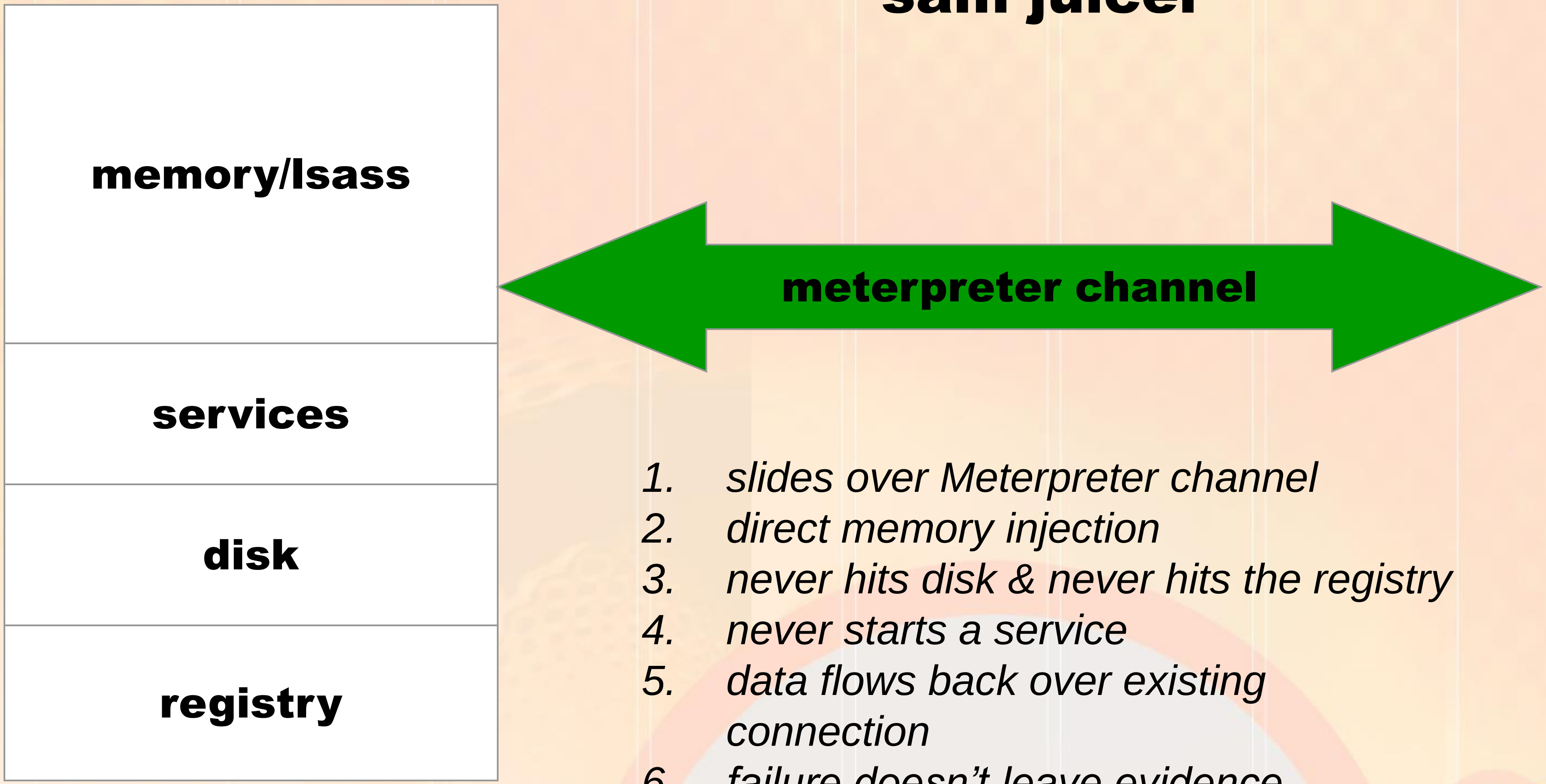
why pwdump should not be used

1. *opens a remote share*
2. *hits disk*
3. *starts a service to do dll injection*
4. *hits registry*
5. *creates remote registry conn*
6. *often fails and doesn't clean up*



hiding in memory

sam juicer



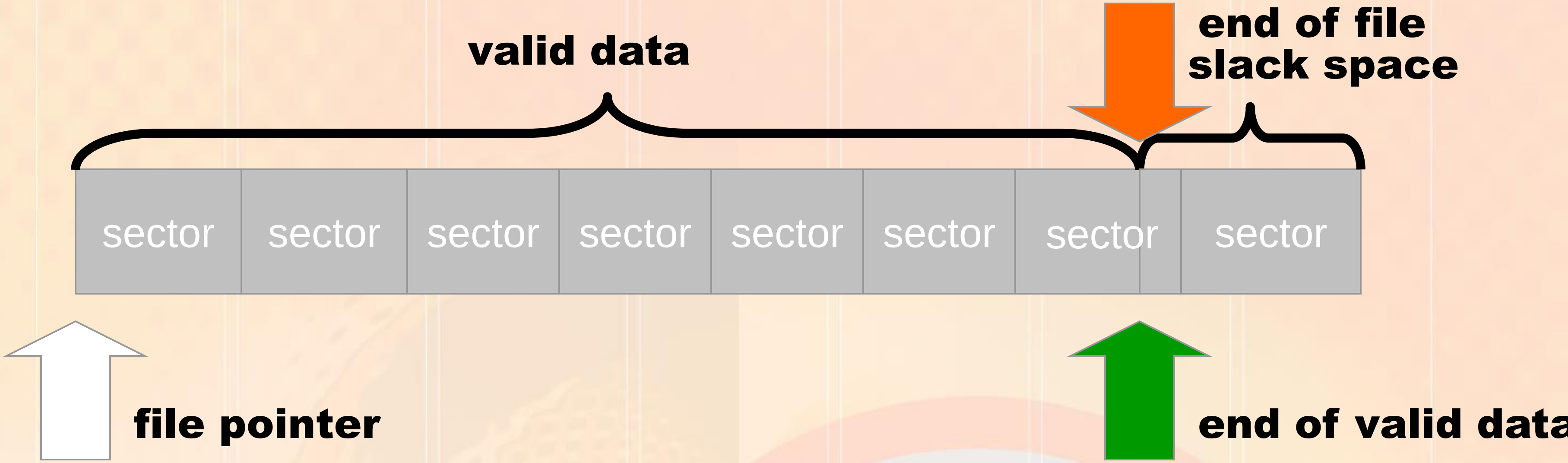
1. slides over Meterpreter channel
2. direct memory injection
3. never hits disk & never hits the registry
4. never starts a service
5. data flows back over existing connection
6. failure doesn’t leave evidence

slacker

- *hiding files in NTFS slack space*
    - *technique*
        - *take advantage of NTFS implementation oddity*
        - *move logical and physical file pointers in certain ways to avoid having data zeroed out*
    - *features*
        - *file hiding*
            - *splitting + slack space hiding*
        - *difficult to detect*

slacker vs NTFS

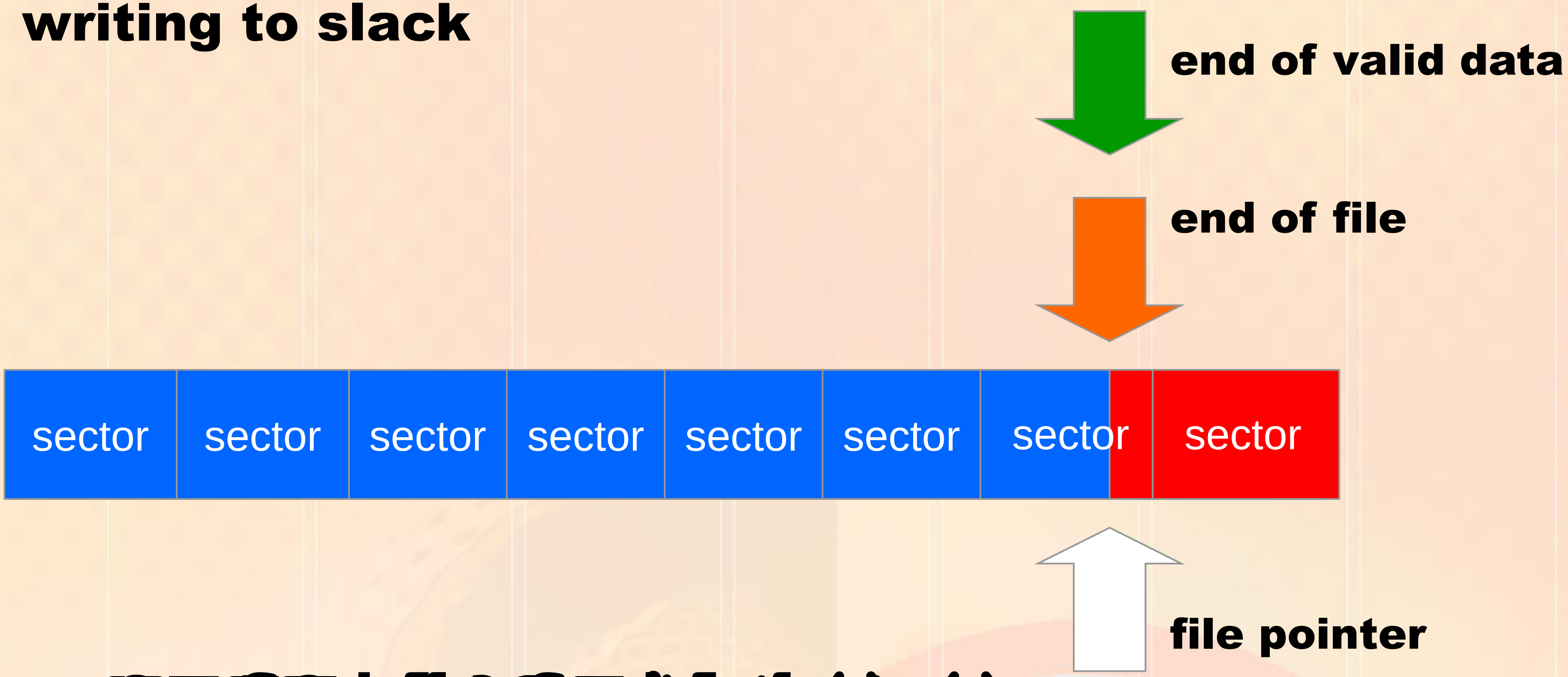
standard file setup



1 cluster (4096b) = 8 sectors (512b)

slacker vs NTFS

writing to slack



[illegible]

1 cluster (4096b) = 8 sectors (512b)

slacker

check out the other panel

- *future work*
  - *redundancy, intelligent slack selection*
  - *undetectable obfuscation*

taking down the coders

- *serious issues with identifying embedded application-layer attacks*

- *old IDS techniques are being resurfaced in the app space as valid for HTTP+ layer attacks*

- *if you can’t see the attack that gets you on the box to begin with then that’s the real problem…*

**FUTURE RESEARCH BY VINNIE, FOSTER, AND WHOEVER ELSE IS INTERESTED*

what we’ve defeated

1. *temporal locality (time stamps)*
2. *spatial locality (file location)*
3. *data recovery*
4. *file signatures*
5. *hashing*
6. *keywords*
7. *reverse engineering*
8. *profiling*
9. *effectiveness/info overload*
10. *disk access/hiding in memory*
11. *a lot of tools*
12. *software*

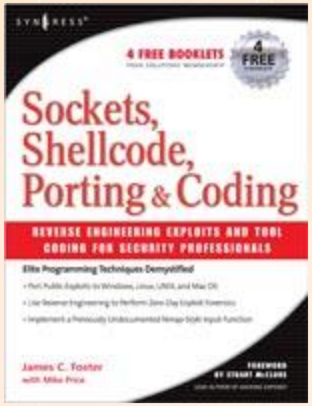
zip it up, and zip it out...

- *what?*
  - *slides*
  - *advisories*
  - *exploit code*
  - *Metasploit Anti-Forensic Investigation Arsenal (MAFIA)*
- *where?*
  - *www.metasploit.com/projects/antiforensics/*
  - *www.blackhat.com*

…all questions to be answered at the nearest watering hole

shoutouts and thanks

muirnin, skape, hdm, optyx, spoonm, thief, ecam, senorpence, tastic, #vax, arimus, oblique, tony B, burnett, asc, j0hnny



SYNGRESS

4 FREE BOOKLETS

4 FREE

Sockets, Shellcode, Porting & Coding

REVERSE ENGINEERING EXPLOITS AND TOOL CODING FOR SECURITY PROFESSIONALS

Elite Programming Techniques Demystified

- Port Public Exploits to Windows, Linux, UNIX, and Mac OS
- Use Reverse Engineering to Perform Zero-Day Exploit Forensics
- Implement a Previously Undocumented Nmap-Style Input Function

James C. Foster
with Mike Price

FOREWORD BY STUART McCLURE

"Shameless plug for Foster and Vinnie's new book"