Forensic Tool Quirks

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Outline

- Overview of computer forensics at NIST
- Quirks uncovered
  - Write Blocking
  - Acquisition to an image file
  - Restoration from an image file
  - Other
- Questions and answers

Where is CFTT?

- US government, executive branch
- Department of Commerce (DOC)
- National Institute of Standards and Technology (NIST)
- Information Technology Lab (ITL)
- Software Diagnostics and Conformance Testing Division (SDCT)
- Computer Forensics: Tool Testing Project (CFTT)
- Also, the Office of Law Enforcement Standards (OLES) at NIST provides project input

Goals of CF at NIST/ITL

- Establish methodology for testing computer forensic tools (CFTT)
- Provide international standard reference data that tool makers and investigators can use in investigations (NSRL, CFReDS)

Project Sponsors (aka Steering Committee)

- National Institute of Justice (Major funding)
- FBI (Additional funding)
- Department of Defense, DCCI (Equipment and support)
- Homeland Security (Technical input)
- State & Local agencies (Technical input)
- Internal Revenue, IRS (Technical input)
- NIST/OLES (Program management)

Other Related Projects at NIST

- NSRL -- Hash (MD5, SHA1) file signature data base, updated 4 times a year (Doug White, John Tebbutt, Ben Long)
- PDAs and Cell Phones, NIST (Rick Ayers)
- SAMATE -- Software Assurance Metrics and Tool Evaluation (Paul E. Black)
- CFReDS -- Computer Forensics Reference Data Sets (Jim Lyle)

Forensic Tool Features

- … are like a Swiss army knife
  - Blade knife for cutting
  - Punch for making holes
  - Scissors for cutting paper
  - Cork screw for opening Chianti
- Forensic tools can do one or more of …
  - Image a disk (digital data acquisition)
  - Search for strings
  - Recover deleted files

Testing a Swiss Army Knife

- How should tools with a variable set of features be tested? All together or by features?
- Test by feature has a set of tests for each feature: acquisition, searching, recovery
- Examples: EnCase acquisition, iLook string search, FTK file recovery

Good News

- Forensic tools tested work
- Problems found are minor
  - Usually something is omitted
  - Nothing incriminating is created
- Investigators should be aware of the quirks

Write Blocking

- Goal: Prevent changes to a protected drive
- Host interacts with a drive by a command set through an interface
  - Read
  - Write
  - Control & info

Int 13 Extended Write

- DOS Interrupt 13 has three write cmds
  - Write (original write cmd)
  - Write long
  - Extended write (added later for large drives)
- Early write blocker versions only block write & write long

Blocking read commands

- Hardware write block devices …
  - Capture cmds sent from a host on a bus
  - Send cmds to a protected device
  - Return data to a host
- Some devices may …
  - Substitute a different cmd
  - Cache results and not issue cmd to device. If the protected device is reconfigured to report a different size, a cached size is reported incorrectly
  - Block some read cmds

Allow Reads vs Block Writes

- Block unsafe commands, allow everything else
  - + Always can read, even if new command introduced
  - - Allows newly introduced write commands
- Allow safe commands, block everything else
  - + Writes always blocked
  - - Cannot use newly introduced read commands

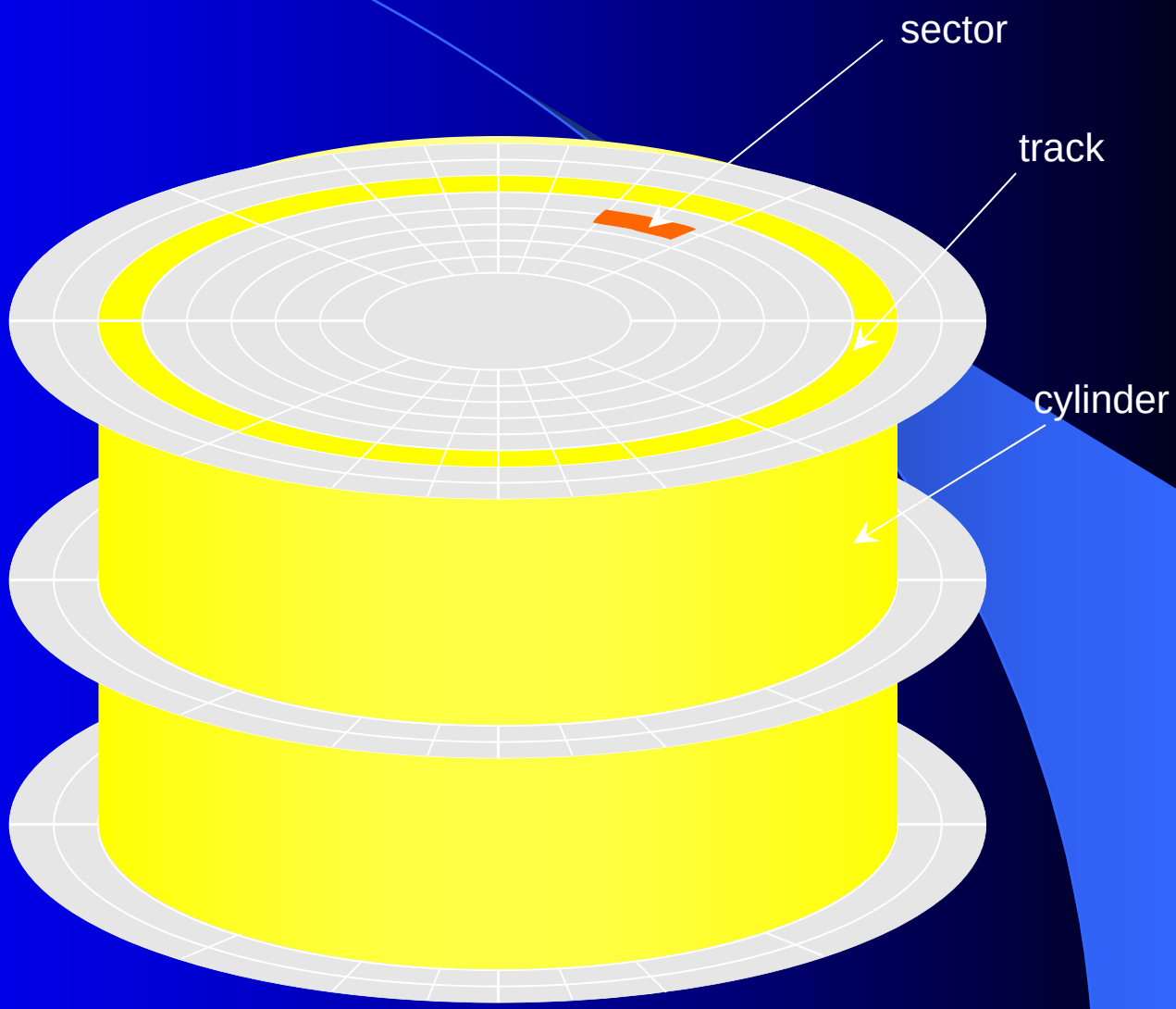
Source Acquisition

- Tool acquires either
  - entire drive (physical drive)
  - partition (logical drive)
- Evaluate the acquisition by either …
  - Hash of data acquired
  - Compare source to a restore

Core Acquisition Requirements

- All visible sectors are acquired
- All hidden sectors are acquired
- All acquired sectors are accurately acquired
- Benign fill of faulty sectors
- Error conditions

Hard Drive Organization



Odd Sectors

- Use dd to acquire either a physical or logical drive with an odd sector count and the last sector is omitted.
- Occurs in the 2.4 kernel and earlier.
- The current 2.6 kernel does not have the problem.

BIOS Lies

- DOS based acquisition via BIOS interface
- Some BIOSs group several physical cylinders together into a logical cylinder
- There may be a fractional logical cylinder left over.
- In addition, some BIOSs may underreport the number of logical cylinders by 1 cylinder

More BIOS Lies

- Say a drive has 4003 physical cylinders but the BIOS groups 4 cylinders into one logical cylinder. The BIOS reports 1000 logical cylinders (4000 physical cylinders).
- Some tools acquire 1000 logical cylinders and miss the last 3 physical cylinders.
- If the BIOS underreports the size, some tools fail to adjust and acquire only 999 logical (3996 physical sectors).

Missing Sectors on Restore

- Restore an image of an `IBM-DTLA-307020 with 40188960 sectors` to an identical drive the results are …
- `Sectors Compared 40188960`
  `Sectors Differ 10395`
  `Diffs range 40178565-40188959`
- Also the partition table gives 255 heads/cylinder and 63 sectors/track.
- That gives 16,065 (63*255) sectors/cylinder
- Note that 40,188,960 mod 16,065 is … 10,395

Restoring an Image

- Testing the accuracy of a restore …
- Compare the original source sector by sector to the restored image

NTFS Partition Restore

- Setup NTFS partition
  - MD5: 92b27b30bee8b0ffba8c660fa1590d49
  - 27,744,192 sectors
  - Each sector filled with sector LBA & disk ID
- Acquire partition
  - Total Sectors:27,744,191
  - 494A6ED8A827AD9B5403E0CC89379956
- Rehash (minus last sector) -- still no match

More NTFS

- Restore image to NTFS partition
- Compare to original
  - Sectors differ: 47
- Restore was in Windows XP …
- Restore again, unpower drive, no system shutdown. Compare to original
  - Sectors differ: 8
  - Diffs range: 27,744,184-27,744,191

NTFS Resolution

- Examine the eight sectors
  - Last sector not imaged
  - Other seven are a second copy of seven sectors starting at offset 27,744,120 -- Know this because each sector is tagged with LBA
- Verification:

Acquisition hash: 494a6ed8a827ad9b5403e0cc89379956

```
xena:/Users/jimmy root# dd bs=512 if=/dev/disk2s11 of=~jimmy/nt.dd
xena.local(1009)==> dd if=nt.dd bs=512 skip=27744120 count=7 of=end.dd
xena.local(1012)==> dd if=nt.dd bs=512 count=27744184 of=chunk.dd
xena.local(1013)==> cat chunk.dd end.dd | md5
494a6ed8a827ad9b5403e0cc89379956
xena.local(1022)==> md5 nt.dd
MD5 (nt.dd) = 92b27b30bee8b0ffba8c660fa1590d49
```

Faulty Sector Behaviors

- Some sectors adjacent to faulty sector missed
  - ATA interface: 8 sector window
  - USB interface: variable size window < 64
  - FW interface: variable, but different from USB
- Missed sectors filled with unknown data
- Image file gets out of sync

Other Quirks

- Hash Quirks
  - Screen hash differ from log file
  - Multiple hashes: SHA ok, MD5 wrong; hardware dependent

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