Computer Forensics Tool Testing at NIST

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Outline

- Overview of computer forensics at NIST
- Description of CFTT and NSRL projects
- Questions and answers

Outline of an Investigation

- Get proper authorization
- Seize evidence (Hard drives, floppies …)
- Create duplicates for analysis
- Analyze the duplicates
  - Exclude known benign files
  - Examine obvious files
  - Search for hidden evidence
- Report results

Investigators Need …

Computer forensic investigators need tools that …

- Work as they should,
- Produce results admissible in court, and
- Reference data to reduce analysis workload

Goals of CF at NIST

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

Project Sponsors

- NIST/OLES (Program management)
- NIJ (Major funding)
- FBI (Additional funding)
- DCCC (Equipment and support)
- Homeland Security (Technical input)
- State & Local agencies (Technical input)

Why NIST/ITL is involved

- **Mission: Assist federal, state & local agencies**
- **NIST is a neutral organization – not law enforcement or vendor**
- **NIST provides an open, rigorous process**

Computer Forensics in ITL

- Located in Software Diagnostics and Conformance Testing (SDCT) Division
  - Includes development of specifications and conformance tests for use by agencies and industry
  - Work is funded by Federal agencies and NIST internal funds
- Homeland Security support of agencies investigating terrorist activities

A Problem for Investigators

Do forensic tools work as they should?

- Software tools must be …
  - Tested: accurate, reliable & repeatable
  - Peer reviewed
  - Generally accepted
- … by whom?
- Results of a forensic analysis must be admissible in court

CFTT Presentation Overview

- Project Tasks
- Current activities
- Challenges
- Testing Hard Drive Imaging Tools
- Benefits of CFTT

Project Tasks

- Identify forensics functions e.g.,
  - disk imaging,
  - hard drive write protect,
  - deleted file recovery
- Develop specification for each function
- Peer review of specification
- Test methodology for each function
- Test Tools (by function) & Report results

Current Activities

- Hard drive imaging tools
- Software hard drive write protect
- Hardware hard drive write protect
- Deleted file recovery
- String Searching

Challenges

- No standards or specifications for tools
- Arcane knowledge domain (e.g. DOS, Windows drivers)
- Reliably faulty hardware
- Many versions of each tool

Overview of Methodology

- CFTT directed by Steering Committee
- Functionality driven
- Specifications developed for specific categories of activities, e.g., disk imaging, hard drive write protect, etc.
- Test methodology developed for each category

Developing a Specification

After tool function selected by SC …

- Focus group (law enforcement + NIST) develop tool function specification
- Spec posted to web for public comment
- Comments incorporated
- Develop test environment

Tool Test Process

After SC selects a tool …

- Acquire tool & review documentation
- Select test cases
- Execute test cases
- Produce test report

Disk Imaging Test Parameters

Parameter	Value
Functions	Copy, Image, Verify
Source interface	BIOS to IDE, BIOS to SCSI, ATA, ASPI, Legacy BIOS
Dst interface	
Relative size	Src=Dst, Src<Dst, Src>Dst
Errors	None, Src Rd, Dst Wt, Img R/W/C
Object type	Disk, FAT12/16/32, NT, Ext2
Remote access	Yes, no

Capabilities to test disk imaging

- Accuracy of copy
  - Compare disks
  - Initialize disk sectors to unique content
- Verify source disk unchanged
- Corrupt an image file
- Error handling: reliably faulty disk

Test Case Structure: Setup

1. Record details of source disk setup.
2. Initialize the source disk to a known value.
3. Hash the source disk and save hash value.
4. Record details of test case setup.
5. Initialize a destination disk.
6. If the test requires a partition, create and format a partition on the destination disk.
7. If the test uses an image file, partition and format a disk for the image file.

Test Case Structure: Run Tool

8. If required, setup I/O error
9. If required, create image file
10. If required, corrupt image file
11. Create destination

Test Case Structure: Measure

12. Compare Source to Destination
13. Rehash the Source

Test Logging

- Log everything, automatically if practical
- Hardware, Software, Versions
- Time/date
- Operator

Compare Logging I

- Tool version
- Date/time compiled
- Command line
- Run date/time

```
Z:\ss\DISKCMP.EXE @(#) diskcmp.cpp Version 3.1 Created 10/11/01 at 12:40:22
compiled on Oct 11 2001 at 12:45:27
@(#) support lib zbios.cpp Version 3.1 created 10/11/01 at 12:40:23
support lib compiled Oct 11 2001 at 12:45:36
@(#) zbios.h Version 3.1 Created 10/11/01 at 12:40:24
cmd: Z:\ss\DISKCMP.EXE 01 Cadfael 80 F6 81 92 /new_log /comment SN
run start Sat Oct 19 13:09:25 2002
run finish Sat Oct 19 15:16:06 2002
elapsed time 2:6:41
```

Compare Logging II

- Drive documentation

```
Source Drive 0x80, BIOS: Extensions Present
Interrupt 13  bios  1023/254/63 (max cyl/hd values)
Interrupt 13  ext  16383/016/63 (number of cyl/hd)
40188960 total number of sectors from the BIOS
IDE disk: Model (IBM-DTLA-307020) serial # (YHDYHLD2691)
Max number of user addressable sectors 40188960
Destination Drive 0x81, BIOS: Extensions Present
Interrupt 13  bios  1023/254/63 (max cyl/hd values)
Interrupt 13  ext  16383/016/63 (number of cyl/hd)
58633344 total number of sectors BIOS
IDE disk: Model (WDC WD300BB-00CAA0) serial # (WD-WMA8H2140350)
Max number of user addressable sectors 58633344
```

Compare Logging III

- Note sectors compared, match & differ
- State of excess sectors (dst fill => undisturbed)

```
Sectors compared: 40188960
Sectors match:    40188960
Sectors differ:          0

Source 18444384 fewer than destination
Zero fill:                 0
Src Byte fill (F6):        0
Dst Byte fill (92): 18444384
Dst fill range:  40188960-58633343
```

Legacy BIOS Quirks

- Some may under report drive size
- Example, Quantum SIROCCO1700A has 3335472 sectors 3309/16/63 spc 1008
- BIOS: 3,330,432 sectors with geometry 826/64/63 spc 4032
- BIOS under reports by 1.25 logical cyls and 5 physicals

Compare Logging IV

```
Source Drive 0x80, BIOS: Legacy
Interrupt 13  bios  0825/063/63 (max cyl/hd values)
Interrupt 13  ext  00826/064/63 (number of cyl/hd)
3330432 total number of sectors reported via interrupt 13 from the BIOS
IDE disk: Model (QUANTUM SIROCCO1700A) serial # (111610113604)
Max number of user addressable sectors reported by ATA identify device command 3335472
--------------------------------------
Destination Drive 0x81, BIOS: Legacy
Interrupt 13  bios  0825/063/63 (max cyl/hd values)
Interrupt 13  ext  00826/064/63 (number of cyl/hd)
3330432 total number of sectors reported via interrupt 13 from the BIOS
IDE disk: Model (QUANTUM SIROCCO1700A) serial # (111615915652)
Max number of user addressable sectors reported by ATA identify device command 3335472
----------------------------------------
Sectors compared:  3335472
Sectors match:     3334463
Sectors differ:      1009
Bytes differ:      494363
Diffs range 36460, 3334464-3335471
```

Bad Sector Error Log

```
 Make sector at LBA 36460 appear bad
return code 00010 on command 00002 from disk 00080
at address 00009/00002/00047
Bios disk geometry: 00825/00063/00063
Monitor BIOS interrupt 13h (disk service)
baddisk  compiled on 10/11/01 at 12:43:50
@(#) Version 3.1 Created 10/11/01 at 12:41:45
Now (10/16/01 at 15:21:01) Going . . .  TSR
 -------------------------------
return code 00010 on command 00010 from disk 00080
at address 00009/00002/00047
Bios disk geometry: 00825/00063/00063
Monitor BIOS interrupt 13h (disk service)
baddisk  compiled on 10/11/01 at 12:43:50
@(#) Version 3.1 Created 10/11/01 at 12:41:45
Now (10/16/01 at 15:21:02) Going . . .  TSR
```

Evaluating Test Results

If a test exhibits an anomaly …

1. Look for hardware or procedural problem
2. Anomaly seen before
3. If unique, look at more cases
4. Examine similar anomalies

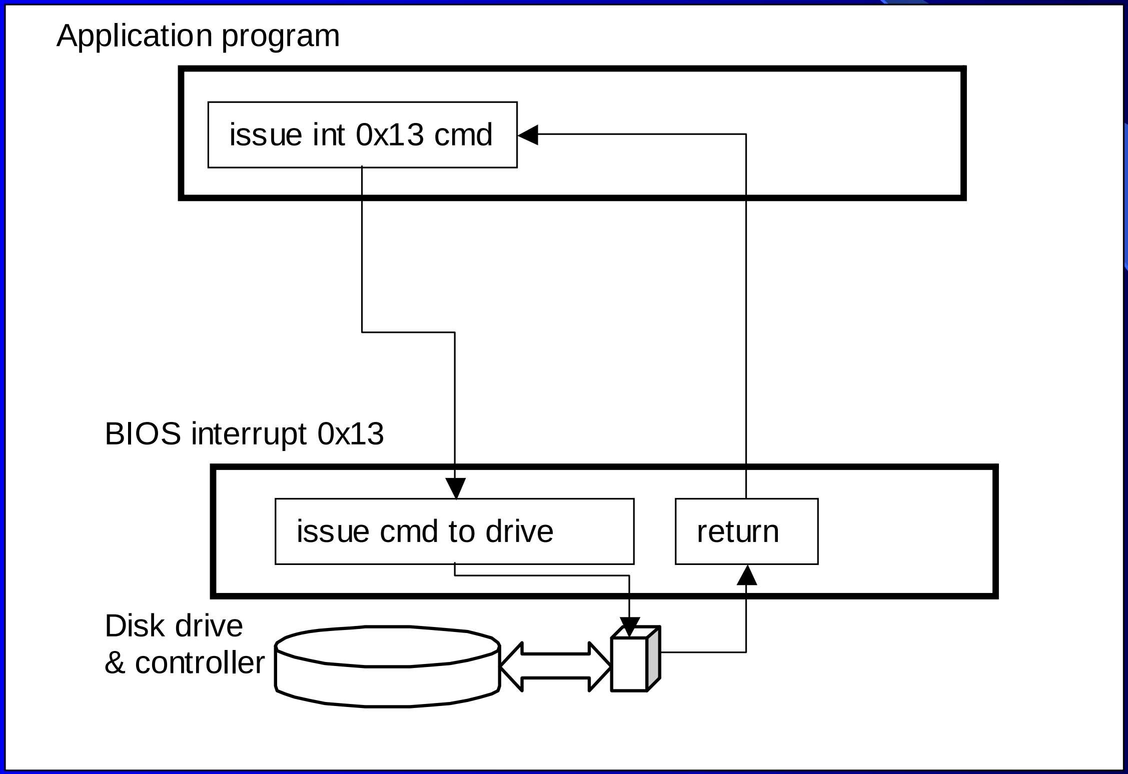
Refining the Test Procedure

- During **dd** testing some results seemed to indicate that the Linux environment was making a change to the source disk.
- After investigation we found that the problem was actually the test procedure.

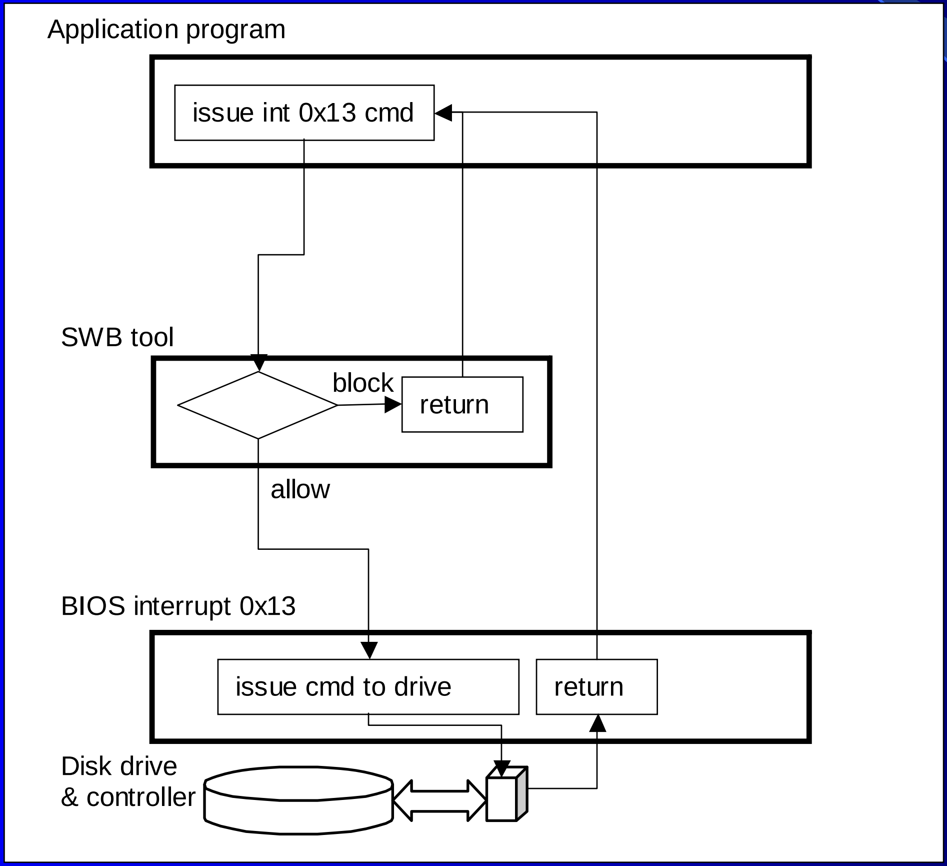
Hard Drive Write Protect

- Can be done either in hardware or software
- Software write protection limited to specific environment: BIOS access or device driver
- Hardware write protection more general

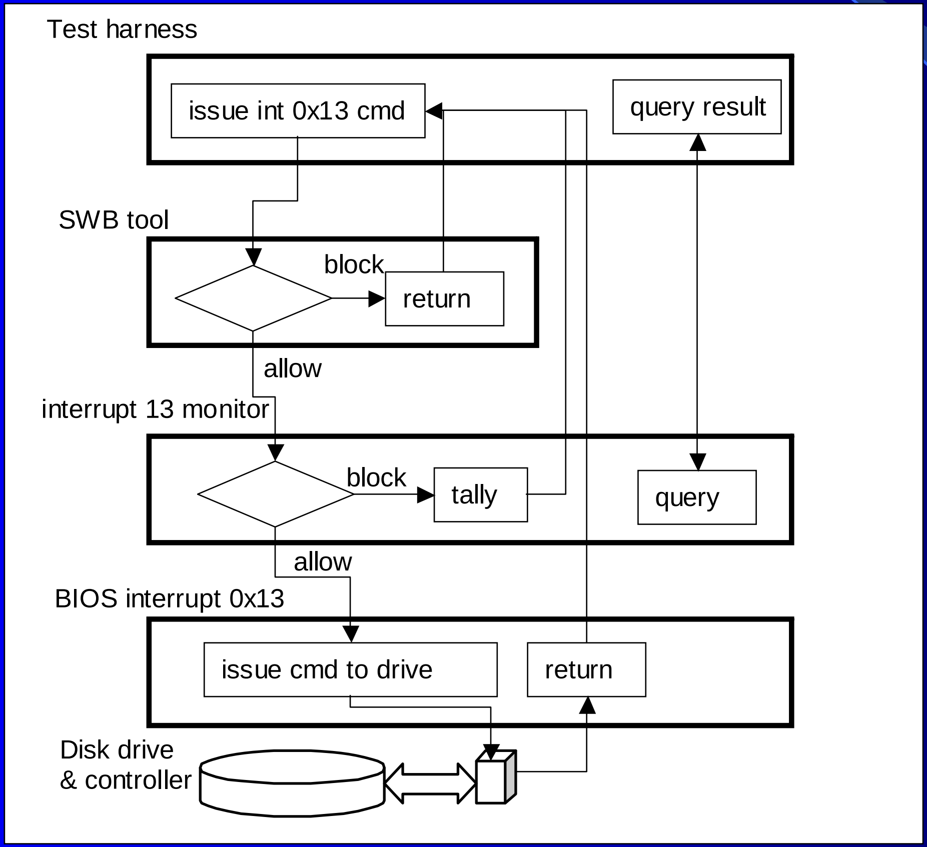
Hard Drive BIOS Access



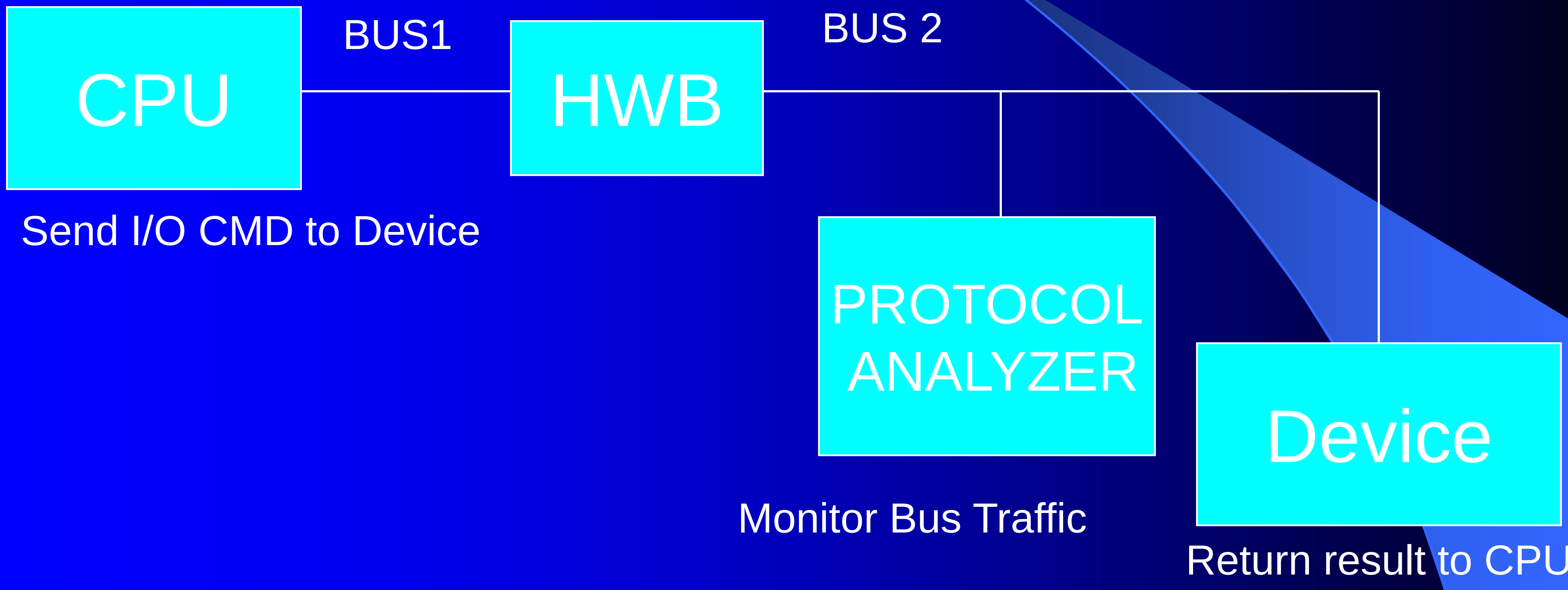
SWB Tool Operation



Test Harness Operation



HWB Testing



Send I/O CMD to Device

Monitor Bus Traffic

Return result to CPU

Impact

- Release 18 (Feb 2001) - A US government organization was doing some testing and uncovered an issue under a specific set of circumstances.
- Linux doesn’t use the last sector if odd
- Several vendors have made product or documentation changes
- CFTT cited in some high profile court cases

Available Specifications

- Hard Drive Imaging (e.g., Safeback, EnCase, Ilook, Mares imaging tool)
- Write Block Software Tools (e.g., RCMP HDL, Pdblock, ACES)
- Write Block Hardware Devices (A-Card, FastBlock, NoWrite) – not final

Specifications Under Development

- String Searching
- Deleted File Recovery
- Revised Disk Imaging

Available Test Reports

- Sydex SafeBack 2.0
- NTI Safeback 2.18
- EnCase 3.20
- GNU dd 4.0.36 (RedHat 7.1)
- FreeBSD 4.4 dd
- RCMP HDL V0.8

Test Reports in Production

- RCMP HDL V0.4
- RCMP HDL V0.5
- RCMP HDL V0.7

Available Testing Software

- FS-TST – tools to test disk imaging: drive wipe, drive compare, drive hash (SHA1), partition compare. (DCCI uses these tools)
- SWBT – tools to test interrupt 13 software write blockers

Benefits of CFTT

Benefits of a forensic tool testing program

- Users can make informed choices
- Neutral test program (not law enforcement)
- Reduce challenges to admissibility of digital evidence
- Tool creators make better tools

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