MAY 06

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NIJ

Special REPORT

Test Results for Hardware Write Block Device: Digital Intelligence UltraBlock SATA (FireWire Interface)

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NCJ 214067

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Glenn R. Schmitt
Acting Director

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NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

Contents

Introduction

The Computer Forensics Tool Testing (CFTT) program is a joint project of the National Institute of Justice (NIJ), the research and development organization of the U.S. Department of Justice, and the National Institute of Standards and Techonology's (NIST's) Office of Law Enforcement Standards (OLES) and Information Technology Laboratory (ITL). CFTT is supported by other organizations, including the Federal Bureau of Investigation, the U.S. Department of Defense Cyber Crime Center, Internal Revenue Service Criminal Investigation's Electronic Crimes Program, and the U.S. Department of Homeland Security's Bureau of Immigration and Customs Enforcement and U.S. Secret Service. The objective of the CFTT program is to provide measurable assurance to practitioners, researchers, and other applicable users that the tools used in computer forensics investigations provide accurate results. Accomplishing this requires the development of specifications and test methods for computer forensics tools and subsequent testing of specific tools against those specifications.

Test results provide the information necessary for developers to improve tools, users to make informed choices, and the legal community and others to understand the tools' capabilities. This approach to testing computer forensic tools is based on well-recognized methodologies for conformance and quality testing. The specifications and test methods are posted on the CFTT Web site (http://www.cftt.nist.gov/) for review and comment by the computer forensics community.

This document reports the results from testing the **Digital Intelligence UltraBlock SATA (FireWire Interface)** write blocker, against the *Hardware Write Blocker (HWB) Assertions and Test Plan Version 1.0*, available at the CFTT Web site (http://www.cftt.nist.gov/HWB-ATP-19.pdf). This specification identifies the following top-level tool requirements:

- A hardware write block (HWB) device shall not transmit a command to a protected storage device that modifies the data on the storage device.
- An HWB device shall return the data requested by a read operation.
- An HWB device shall return without modification any access-significant information requested from the drive.
- Any error condition reported by the storage device to the HWB device shall be reported to the host.

Test results from other software packages and the CFTT tool methodology can be found on NIJ's computer forensics tool testing Web page, http://www.ojp.usdoj.gov/nij/topics/ecrime/cftt.htm.

Test Results for Hardware Write Block Devices

Device Tested:	Digital Intelligence UltraBlock SATA by Tableau
Model:	T3u
Serial No:	000ECC01000531B2
Firmware:	October 4, 2004 15:28:51
Host to Blocker Interface:	FireWire
Blocker to Drive Interface:	SATA
Supplier:	Digital Intelligence
Address:	1325 Pearl Street Waukesha, WI 53186 866–DIGINTEL (866–344–4683) www.DigitalIntelligence.com

1 Results Summary by Requirements

An HWB device shall not transmit a command to a protected storage device that modifies the data on the storage device.
For all test cases run, the device always blocked any commands that would have changed user or operating system data stored on a protected drive.

An HWB device shall return the data requested by a read operation.
For all test cases run, the device always allowed commands to read the protected drive.

An HWB device shall return without modification any access-significant information requested from the drive.
For all test cases run, the device always returned access-significant information from the protected drive without modification.

Any error condition reported by the storage device to the HWB device shall be reported to the host.
For all test cases run, the device always returned error codes from the protected drive without modification.

2 Test Case Selection

Since a protocol analyzer was not available for the interface between the blocker and the protected drive, the following test cases were appropriate: HWB–02, HWB–04, HWB–05, HWB–07, HWB–08, and HWB–09.

For test case HWB–04, two variations were selected: file (attempt to use operating system commands to create and delete files and directories from a protected drive) and image (use an imaging tool to attempt to write to a protected drive).

For test case HWB–07, one variation was selected: ix (use a stand-alone imaging tool (IXimager) to read from a protected drive).

3 Testing Environment

The tests were run in the NIST CFTT lab. This section describes the hardware (test computers and hard drives) available for testing.

3.1 Test Computers

Three test computers were used: **JohnSteed, JohnStone** and **Chan**. **JohnSteed** and **JohnStone** have the following configuration:

FIC IC–VL67 (865G; S478; 800MHz) Intel® Desktop Motherboard
Phoenix-Award BIOS version v6.00PG
Intel® Pentium® 4 CPU
Plextor DVDR PX–716A, ATAPI CD/DVD–ROM drive
WDC WD800JB–00JJC0, 80 GB ATA disk drive
1.44MB floppy drive
Three IEEE 1394 ports
Four USB ports

Chan has the following configuration:

Asus P4P8T Intel® (865G/ICH 5 chipsets, FSB 800/533/400MHz) Motherboard
AMIBIOS© American Megatrends Asus P4P8T–SP ACPI BIOS revision 1003
Intel® Pentium® 4 CPU
Plextor DVDR PX–716A, ATAPI CD/DVD–ROM drive
WDC WD800JB–00JJC0, 80 GB ATA disk drive
Five IEEE 1394 ports
Six USB ports
Memory Card reader

3.2 Protocol Analyzer

A Data Transit bus protocol analyzer (Bus Doctor Rx) was used to monitor and record commands sent from the host to the write blocker. Two identical protocol analyzers were available for monitoring commands.

One of two Dell laptop computers (either Chip or Dale) was connected to each protocol analyzer to record commands observed by the protocol analyzer.

3.3 Hard Disk Drives

The hard disk drives that were used were selected from the SATA drives listed below. These hard drives were mounted in removable storage modules. The drives were set up in a variety of ways with the common partition types (FAT and NTFS) represented. The setup of each drive is documented below.

```
Drive label: 09
Partition table Drive /dev/hdg
09728/254/63 (max cyl/hd values)
09729/255/63 (number of cyl/hd)
156301488 total number of sectors
IDE disk: Model (WDC WD800JD-32HKA0) serial # (WD-WMAJ91407692)
 N   Start LBA Length    Start C/H/S End C/H/S   boot Partition type
 1 P 000000063 000016002 0000/001/01 0000/254/63      01 Fat12
 2 X 000016065 156280320 0001/000/01 1023/254/63      0F extended
 3 S 000000063 020482812 0001/001/01 1023/254/63      0B Fat32
 4 S 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
 5 P 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
 6 P 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
```

```
Drive label: 0A
Partition table Drive /dev/hde
09728/254/63 (max cyl/hd values)
09729/255/63 (number of cyl/hd)
156301488 total number of sectors
IDE disk: Model (WDC WD800JD-32HKA0) serial # (WD-WMAJ91508343)
 N   Start LBA Length    Start C/H/S End C/H/S   boot Partition type
 1 P 000000063 156280257 0000/001/01 1023/254/63 Boot 07 NTFS
 2 P 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
 3 P 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
 4 P 000000000 000000000 0000/000/00 0000/000/00      00 empty entry
```

P primary partition (1–4)
S secondary (sub) partition
X primary extended partition (1–4)
x secondary extended partition

3.4 Support Software

The software in the following table was used to send commands to the protected drive. One widely used imaging tool, IXimager, was used to generate disk activity (reads and writes) consistent with a realistic scenario of an accidental modification of an unprotected hard drive during a forensic examination. This does not imply an endorsement of the imaging tool.

Program	Description
sendSCSI	A tool to send SCSI commands wrapped in the USB or IEEE 1394 (FireWire) protocols to a drive.
FS–TST	Software from the FS–TST tools was used to generate errors from the hard drive by trying to read beyond the end of the drive. The FS–TST software was also used to setup the hard drives and print partition tables and drive size.
IXimager	An imaging tool (ILook IXimager version 1.0, August 25, 2004) for test case 04-img.

4 Test Results

The main item of interest for interpreting the test results is determining the conformance of the device with the test assertions. Conformance with each assertion tested by a given test case is evaluated by examining the Blocker Input and Blocker Output boxes of the test report summary.

4.1 Test Results Report Key

A summary of the actual test results is presented in this report. The following table presents a description of each section of the test report summary.

Heading	Description
First Line	Test case ID; name, model, and interface of device tested.
Case Summary	Test case summary from *Hardware Write Blocker (HWB) Assertions and Test Plan Version 1.0.*
Assertions Tested	The test assertions applicable to the test case, selected from *Hardware Write Blocker (HWB) Assertions and Test Plan Version 1.0.*
Tester Name	Name or initials of person executing test procedure.
Test Date	Time and date that test was started and completed.
Test Configuration	Identification of the following: 1. Host computer for executing the test case. 2. Laptop attached to each protocol analyzer. 3. Protocol analyzers monitoring each interface. 4. Interface between host and blocker. 5. Interface between blocker and protected drive. 6. Execution environment for tool sending commands from the host.
Hard Drives Used	Description of the protected hard drive.
Blocker Input	A list of commands sent from the host to the blocker. For test case HWB–02, a list of commands sent is provided. For test cases HWB–02, HWB–04, and HWB–07, an SHA1 value for the entire drive is provided for reference. For test case HWB–05, a string of known data from a given location is provided for reference.
Blocker Output	For test cases HWB–02, HWB–04, and HWB–07, an SHA1 value computed after commands are sent to the protected drive is given for comparison to the reference SHA1 value. For test case HWB–05, a string read from a given location is provided for comparison to known data.

Heading	Description
	For test case HWB–08, the number of sectors determined for the protected drive and the partition table are provided. For test case HWB–09, any error return obtained by trying to access a nonexistent sector of the drive is provided.
Results	Expected and actual results for each assertion tested.
Analysis	Whether or not the expected results were achieved.

4.2 Test Details

Test Case HWB-02 Variation hwb-02 Digital Intelligence UltraBlock SATA (FireWire by Tableau)

Case Summary:	HWB-02 Identify modifying commands blocked by the HWB.
Assertions Tested:	HWB-AM-01 The HWB shall not transmit any modifying category operation to the protected storage device.
Tester Name:	JRL
Test Date:	run start Fri Nov 18 14:33:34 2005 run finish Fri Nov 18 14:16:40 2005
Test Configuration:	HOST: JohnStone HostToBlocker Monitor: Chip HostToBlocker PA: AA00155 HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none BlockerToDrive Interface: SATA Run Environment: Knoppix
Drives:	Protected drive: 09 09 is a SATA drive with 156301488 sectors (80 GB)
Blocker Input:	SHA of 09 is FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 - Commands Sent to Blocker 42 SBP2 OP=READ(10) 2 SBP2 OP=WRITE(10) 1 SBP2 OP=WRITE(12) 1 SBP2 OP=WRITE BUFFER 1 SBP2 OP=WRITE LONG 1 SBP2 OP=WRITE SAME 2 SBP2 OP=WRITE/VERIFY 1 SBP2 OP=XDWRITE(10) 1 SBP2 OP=XDWRITEREAD(10) 1 SBP2 OP=XPWRITE(10)
Blocker Output:	CMD: /mnt/floppy/diskhash.csh HWB-02 JohnSteed JRL /dev/sda 09 -after FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 -
Results:	**Assertion & Expected Result** / **Actual Result** AM-01 Modifying commands blocked / Modifying commands blocked

Test Case HWB-02 Variation hwb-02 Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Analysis:	Expected results achieved

Test Case HWB-04 Variation hwb-04-file Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Case Summary:	HWB-04 Attempt to modify a protected drive with forensic tools.
Assertions Tested:	HWB-AM-01 The HWB shall not transmit any modifying category operation to the protected storage device.
Tester Name:	JRL
Test Date:	Run start Tue Dec 13 08:03:23 2005 Run finish Thu Dec 15 07:43:29 2005
Test Configuration:	HOST: Chan HostToBlocker Monitor: none HostToBlocker PA: none HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none BlockerToDrive Interface: SATA Run Environment: WXP
Drives:	Protected drive: 09 09 is a SATA drive with 156301488 sectors (80 GB)
Blocker Input:	SHA of 09 is FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 - Commands are sent to blocker by OS operations: @echo off REM %1 is the directory where alpha, beta & gamma are created REM Redirect the output to a logfile REM hwb-mod . X: > dir-setup.txt echo "mod: %1" mkdir %1\delta rmdir %1\gamma copy %1\beta\zeta.txt %1\alpha copy %1\beta\omega.txt %1\delta del %1\beta\zeta.txt dir %1 /b /s
Blocker Output:	Results for FAT partition: "mod: J:" Final SHA1 value: CMD: /mnt/floppy/diskhash.csh HWB-04-file Poirot JRL /dev/sda 09 -after FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 -
Results:	**Assertion & Expected Result** / **Actual Result** AM-01 Modifying commands blocked / Modifying commands blocked
Analysis:	Expected results achieved

Test Case HWB-04 Variation hwb-04-img Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Case Summary:	HWB-04 Attempt to modify a protected drive with forensic tools.
Assertions Tested:	HWB-AM-01 The HWB shall not transmit any modifying category operation to the protected storage device.
Tester Name:	JRL
Test Date:	Run start Sat Nov 19 12:38:58 2005 run finish Sat Nov 19 15:30:26 2005
Test Configuration:	HOST: JohnSteed HostToBlocker Monitor: none HostToBlocker PA: none HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none BlockerToDrive Interface: SATA Run Environment: IXimager
Drives:	Protected drive: 09 09 is a SATA drive with 156301488 sectors (80 GB)
Blocker Input:	SHA of 09 is FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 - Commands are sent to blocker by imaging tool
Blocker Output:	CMD: /mnt/floppy/diskhash.csh HWB-04-img JohnSteed JRL /dev/sda 09 -after FE7F2F3B735B37F685E13E14AA5FCF1C42561E08 -
Results:	**Assertion & Expected Result** / **Actual Result** AM-01 Modifying commands blocked / Modifying commands blocked
Analysis:	Expected results achieved

Test Case HWB-05 Variation hwb-05 Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Case Summary:	HWB-05 Identify read commands allowed by the HWB.
Assertions Tested:	HWB-AM-02 If the host sends a read category operation to the HWB and no error is returned from the protected storage device to the HWB, then the data addressed by the original read operation is returned to the host.
Tester Name:	JRL
Test Date:	run start Thu Nov 17 11:09:26 2005 run finish Thu Nov 17 11:13:33 2005
Test Configuration:	HOST: JohnStone HostToBlocker Monitor: none HostToBlocker PA: none HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none BlockerToDrive Interface: SATA Run Environment: Knoppix
Drives:	Protected drive: 0A

<table>
<tr><th colspan="2">Test Case HWB-05 Variation hwb-05 Digital Intelligence UltraBlock SATA (FireWire by Tableau)</th></tr>
<tr><td></td><td>0A is a SATA drive with 156301488 sectors (80 GB)</td></tr>
<tr><td>Blocker Input:</td><td>Commands Sent to Blocker
Read sector 32767 for the string: 00002/010/08 000000032767</td></tr>
<tr><td>Blocker Output:</td><td>00032/008/08 000000032767</td></tr>
<tr><td>Results:</td><td><table><tr><th>Assertion & Expected Result</th><th>Actual Result</th></tr><tr><td>AM-02 Read commands allowed</td><td>Read commands allowed</td></tr></table></td></tr>
<tr><td>Analysis:</td><td>Expected results achieved</td></tr>
</table>

<table>
<tr><th colspan="2">Test Case HWB-07 Variation hwb-07 Digital Intelligence UltraBlock SATA (FireWire by Tableau)</th></tr>
<tr><td>Case Summary:</td><td>HWB-07 Read a protected drive with forensic tools.</td></tr>
<tr><td>Assertions Tested:</td><td>HWB-AM-02 If the host sends a read category operation to the HWB and no error is returned from the protected storage device to the HWB, then the data addressed by the original read operation is returned to the host.
HWB-AM-03 If the host sends an information category operation to the HWB and if there is no error on the protected storage device, then any returned access-significant information is returned to the host without modification.</td></tr>
<tr><td>Tester Name:</td><td>JRL</td></tr>
<tr><td>Test Date:</td><td>run start Thu Nov 17 14:55:33 2005
run finish Thu Nov 17 14:23:37 2005</td></tr>
<tr><td>Test Configuration:</td><td>HOST: JohnSteed
HostToBlocker Monitor: none
HostToBlocker PA: none
HostToBlocker Interface: FW
BlockerToDrive Monitor: none
BlockerToDrive PA: none
BlockerToDrive Interface: SATA
Run Environment: Knoppix</td></tr>
<tr><td>Drives:</td><td>Protected drive: 09
09 is a SATA drive with 156301488 sectors (80 GB)</td></tr>
<tr><td>Blocker Input:</td><td>SHA of 09 is FE7F2F3B735B37F685E13E14AA5FCF1C42561E08
-
Commands Sent to Blocker
Commands are sent to blocker by imaging tool</td></tr>
<tr><td>Blocker Output:</td><td>Nov 17 13:30:59 iimager: SHA-1 Value : fe7f2f3b735b37f685e13e14aa5fcf1c42561e08</td></tr>
<tr><td>Results:</td><td><table><tr><th>Assertion & Expected Result</th><th>Actual Result</th></tr><tr><td>AM-02 Read commands allowed</td><td>Read commands allowed</td></tr><tr><td>AM-03 Access Significant Information unaltered</td><td>Access Significant Information unaltered</td></tr></table></td></tr>
</table>

Test Case HWB-07 Variation hwb-07 Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Analysis:	Expected results achieved

Test Case HWB-08 Variation hwb-08 Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Case Summary:	HWB-08 Identify access significant information unmodified by the HWB.
Assertions Tested:	HWB-AM-03 If the host sends an information category operation to the HWB and if there is no error on the protected storage device, then any returned access-significant information is returned to the host without modification.
Tester Name:	JRL
Test Date:	run start Wed Nov 16 09:49:15 2005 run finish Thu Nov 17 09:01:09 2005
Test Configuration:	HOST: JohnStone HostToBlocker Monitor: none HostToBlocker PA: none HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none BlockerToDrive Interface: SATA Run Environment: Knoppix
Drives:	Protected drive: 09 09 is a SATA drive with 156301488 sectors (80 GB)
Blocker Output:	cmd: /mnt/floppy/partab HWB-08 JohnStone JRL /dev/sda 09 -all 156301488 total number of sectors
Results:	**Assertion & Expected Result** / **Actual Result** AM-03 Access Significant Information unaltered / Access Significant Information unaltered
Analysis:	Expected results achieved

Test Case HWB-09 Variation hwb-09 Digital Intelligence UltraBlock SATA (FireWire by Tableau)	
Case Summary:	HWB-09 Determine if an error on the protected drive is returned to the host.
Assertions Tested:	HWB-AM-04 If the host sends an operation to the HWB and if the operation results in an unresolved error on the protected storage device, then the HWB shall return an error status code to the host.
Tester Name:	JRL
Test Date:	run start Thu Nov 17 09:14:57 2005 run finish Thu Nov 17 09:20:46 2005
Test Configuration:	HOST: JohnStone HostToBlocker Monitor: none HostToBlocker PA: none HostToBlocker Interface: FW BlockerToDrive Monitor: none BlockerToDrive PA: none

<table>
<tr><th colspan="2">Test Case HWB-09 Variation hwb-09 Digital Intelligence UltraBlock SATA (FireWire by Tableau)</th></tr>
<tr><td></td><td>BlockerToDrive Interface: SATA
Run Environment: Knoppix</td></tr>
<tr><td>Drives:</td><td>Protected drive: 09
09 is a SATA drive with 156301488 sectors (80 GB)</td></tr>
<tr><td>Blocker Output:</td><td>09728/254/63 (max cyl/hd values)
09729/255/63 (number of cyl/hd)
156301488 total number of sectors
cmd: diskchg HWB-09 JohnStone JRL /dev/sda -read 256302488 0 32
Disk addr lba 256302488 C/H/S 15954/23/30 offset 0
Disk read error 0xFFFFFFFF at sector 15954/23/30</td></tr>
<tr><td>Results:</td><td><table><tr><th>Assertion & Expected Result</th><th>Actual Result</th></tr><tr><td>AM-04 Error code returned</td><td>Error code returned</td></tr></table></td></tr>
<tr><td>Analysis:</td><td>Expected results achieved</td></tr>
</table>

About the National Institute of Justice

NIJ is the research, development, and evaluation agency of the U.S. Department of Justice. NIJ's mission is to advance scientific research, development, and evaluation to enhance the administration of justice and public safety. NIJ's principal authorities are derived from the Omnibus Crime Control and Safe Streets Act of 1968, as amended (see 42 U.S.C. §§ 3721–3723).

The NIJ Director is appointed by the President and confirmed by the Senate. The Director establishes the Institute's objectives, guided by the priorities of the Office of Justice Programs, the U.S. Department of Justice, and the needs of the field. The Institute actively solicits the views of criminal justice and other professionals and researchers to inform its search for the knowledge and tools to guide policy and practice.

Strategic Goals

NIJ has seven strategic goals grouped into three categories:

Creating relevant knowledge and tools

1. Partner with State and local practitioners and policymakers to identify social science research and technology needs.
2. Create scientific, relevant, and reliable knowledge—with a particular emphasis on terrorism, violent crime, drugs and crime, cost-effectiveness, and community-based efforts—to enhance the administration of justice and public safety.
3. Develop affordable and effective tools and technologies to enhance the administration of justice and public safety.

Dissemination

4. Disseminate relevant knowledge and information to practitioners and policymakers in an understandable, timely, and concise manner.
5. Act as an honest broker to identify the information, tools, and technologies that respond to the needs of stakeholders.

Agency management

6. Practice fairness and openness in the research and development process.
7. Ensure professionalism, excellence, accountability, cost-effectiveness, and integrity in the management and conduct of NIJ activities and programs.

Program Areas

In addressing these strategic challenges, the Institute is involved in the following program areas: crime control and prevention, including policing; drugs and crime; justice systems and offender behavior, including corrections; violence and victimization; communications and information technologies; critical incident response; investigative and forensic sciences, including DNA; less-than-lethal technologies; officer protection; education and training technologies; testing and standards; technology assistance to law enforcement and corrections agencies; field testing of promising programs; and international crime control.

In addition to sponsoring research and development and technology assistance, NIJ evaluates programs, policies, and technologies. NIJ communicates its research and evaluation findings through conferences and print and electronic media.

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