BASIS TECHNOLOGY

AFF: The Advanced Forensics Format

AFF®
Advanced Forensic Format

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What is AFF?

- The Advanced Forensic Format (AFF) is an open and extensible file format.
  - Open: Published specification and open source software
  - Extensible: You can store any type of data and metadata
- AFF can store any type of forensic data
  - Disk images
  - Exported files
  - etc.
- Designed and developed by Simson Garfinkel and Basis Technology
  - Some of these slides were created by Simson

Today there are many disk image formats

- Raw (dd)
- Raw with external hash values (dcfldd)
- EnCase Forensic Evidence File (EWF/EVF)
- ILook Investigator IDIF, IRBF and IEIF

- DIBS USA Rapid Action Imaging Device (RAID)
- ProDiscover Image File Format
- PyFlag Seekable GZIP (sgzip)
- SafeBack
- Turner's Digital Evidence Bags (DEB)

Limitations of Popular Formats

Raw:

- No compression
  - Can compress entire file for transport, but not efficient during analysis
- No standardized metadata
  - Metadata must be stored in an external file
  - Format and structure will vary by investigator or tool being used
- No integrity checks
  - MD5/SHA-1 hash values are not included – unless dcfldd is used

EnCase:

- Proprietary
  - Design is not published and changes between versions
- Limited storage of metadata
  - Limited types of metadata can be stored

Benefits of AFF

- Stores arbitrary metadata
- Stores arbitrary types of data
- Wider range of compression levels
  - Can produce images ¼ to ½ the size of EnCase images using LZMA compression
- No practical size limits (64-bit clean)
- Open Source

AFF Schema

- Everything can be defined as a name and value pair:
  - md5 = “6acf1e36e671b926b8d66f974042356e”
  - sha1 = “8231e522bfd63a9c7b832fdc1e6050c7ecf515bb”
  - page1 = b82084a7e161d233b22b0ea7b048afada8d40138a2740d94be9bb0c206d57c616c8fa5e64734eaca31cd14e6cd1dbb5c1d73fc936df49243689476b5ecaacdee457307a7afae71d4737615954a35340ba610198717c827d27356a79ec611ec13d5f814d1ca0e5fd9bedcc7d6b2403901883679 33c9cd90…
- The AFF Schema defines what names are used when storing disk images and exported files.
- You can also define your own name and value pairs:
  - gps = “42.394543, -71.144256”
  - classification = “secret”

Example Disk Image Pairs

imagesize # bytes in image
page0 First data page
    page0_md5 MD5 hash for page0
    page0_md5_sig MD5 digital signature for page0
page1 Second data page
pagesize Data page size
md5 per-disk MD5 hash
sha1 per-disk SHA1 hash

---

case_num Case number
image_gid Unique 128-bit identifier
device_sn Drive serial number
imaging_date Date imaged

… …

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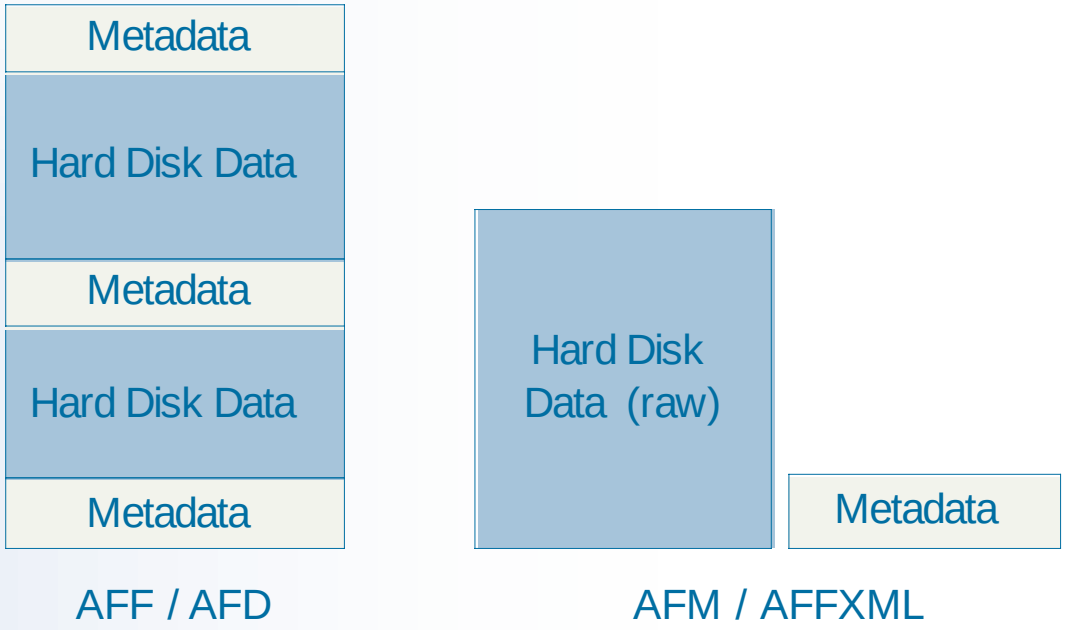
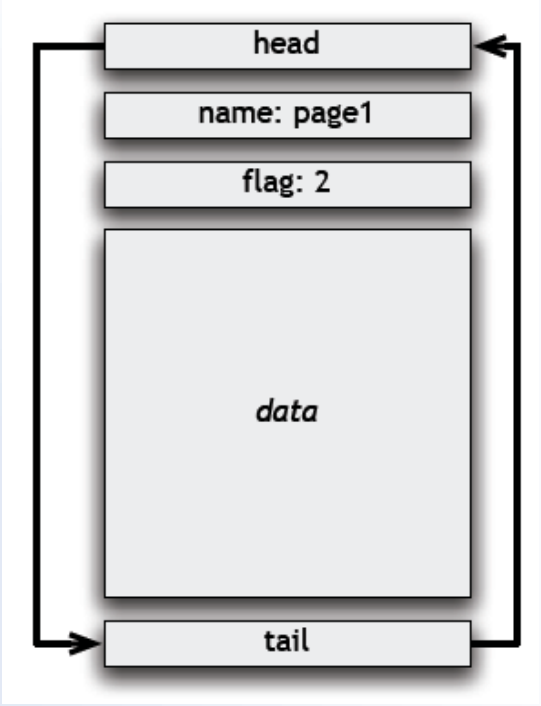
AFF Storage Formats

- There are four AFF storage formats for the schema
- AFF and AFD are embedded formats where the metadata is embedded with the forensic data.
- AFM and AFFXML store the metadata in a file separate from the forensic data (which is stored as a raw file).



AFF segment structure

- AFF, AFD, and AFM use the same data structures to store name and value pairs (called segments)
  - AFFXML uses XML
- Each AFF segment has a head, name, flag, data, and tail.
  - The flag identifies if the data is compressed, etc.



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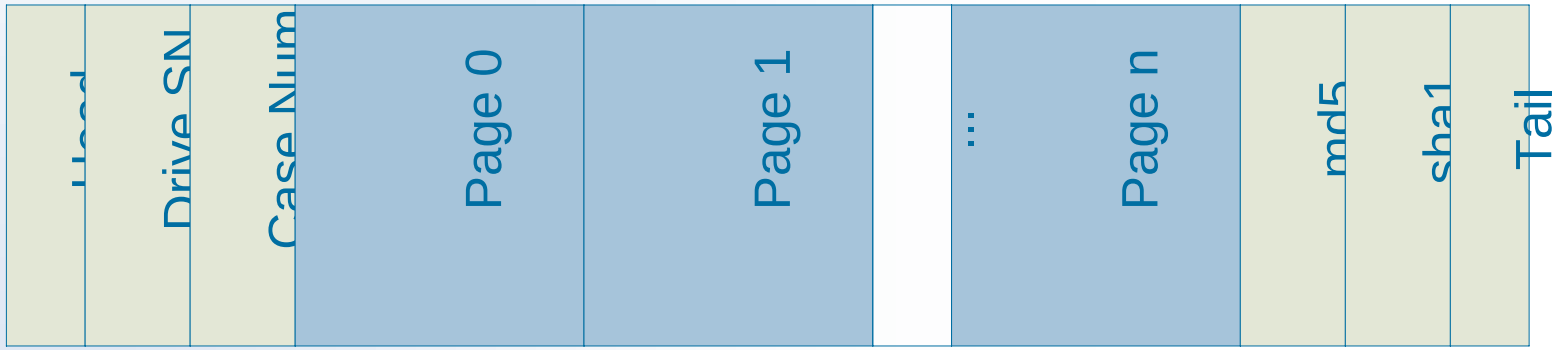
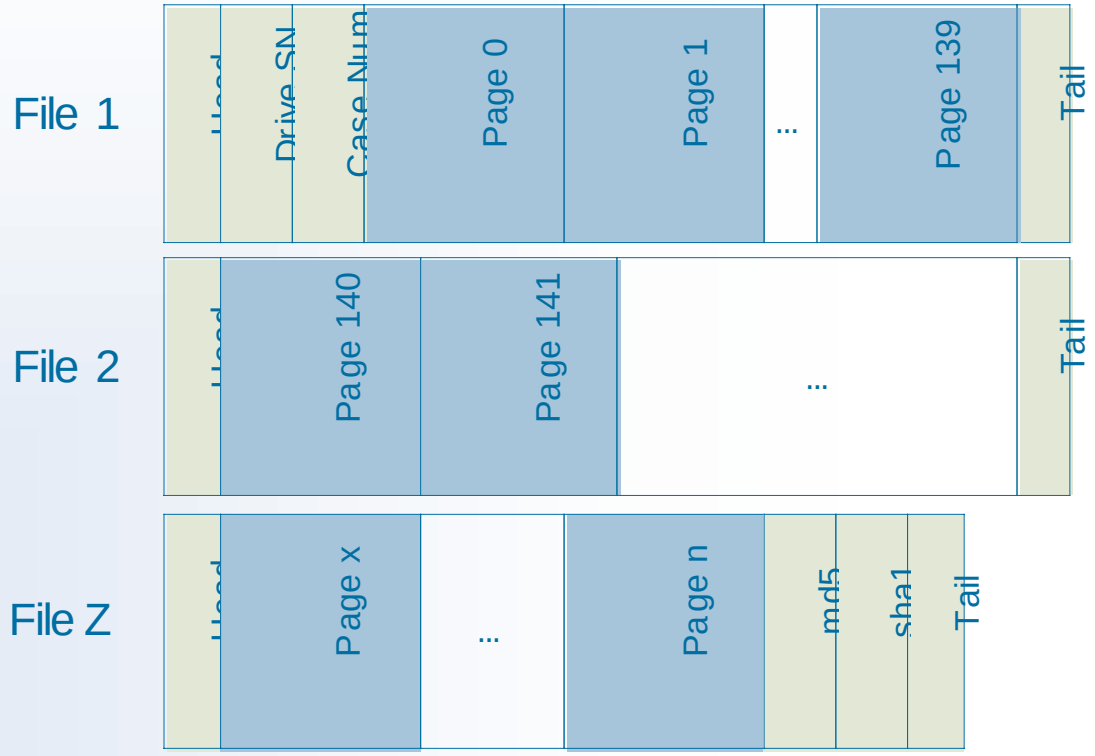
Segment storage

- Hard disk data is broken up into “pages”
  - Typically 16MB each
  - Each page is stored as a segment (name and value pair)
  - Each page can be compressed (or encrypted)
  - Each page can have its own cryptographic hash values
- AFF stores all segments in one large file



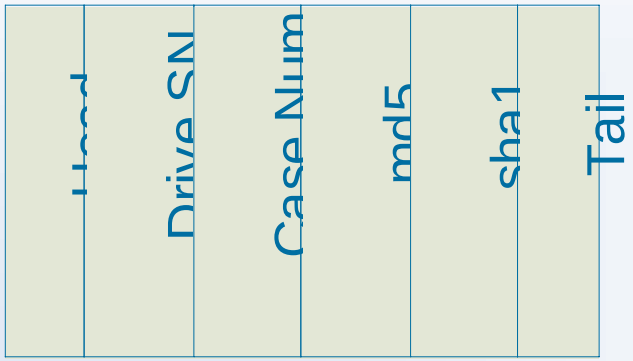
AFD Segment Storage

- AFD stores the segments in multiple AFF files in a single directory
  - 2GB files for FAT32
  - 650MB files for CD
- Each file knows where it fits in the set



AFM / AFFXML Segment Storage

- AFM stores the metadata segments in an AFF file and the hard disk data in a raw file
- AFFXML uses XML to store the metadata segments
- AFM and AFFXML allow you to use any analysis tool that supports raw formats




```
<affinfo name='/project/affs/551.aff'>
    <segsize arg='16777216' />
    <imagesize arg='2'>4290600960</imagesize>
    <md5>5M/87t7f6N4N5koMKb4QPA==</md5>
    <sha1>2XzW2A+kfKIGtmDloxiovqXjWcg=</sha1>
    <badsectors>AAAAAAAAAAA=</badsectors>
    <blanksectors>AASGTQAAAAA=</blanksectors>
</affinfo>
```

AFF example

- Example: AFF file of a good disk (converted from raw).

```
% afinfo -a /project1/affs/47.aff
                          file                 data
Segment                 offset      arg      length    data preview
=======                 =======  =======     ======    ============
pagesize                    585 16777216           0
imagesize                   616        0           8    = 1629831168 (64-bit value)
md5                         657        0          16    .U[...'L....ng..
sha1                        700        0          20    .8..l..).(......kMcI
page0                       748        1    10488912    x....|\u.7..4...^...E.....
page1                  10489688        1    16398437    x...@..=|....6Mh.jz...A...
page2                  26888153        1    16305513    x..}..%E.v.T....'W.t.D...(
page3                  43193694        1    16665964    x...@....E.A..8...05.x..'.
page4                  59859686        1    16742440    x.DyS.0.....m..m{..m..m..m
page5                  76602154        1    16726198    x...@..4.....,}....x.O.M..
page6                  93328380        1    16768092    x...@..9..Vd.|3...NF..u..
...
```

AFFLib and Tools

- AFFLib is an open source library for reading and writing AFF files
- AFF Tools are a collection of tools built using the library:

aimage	Hard disk acquisition tool that writes AFF files
afinfo	Print information about an AFF file
afcat	Print data in AFF file to stdout
afcompare	Compares two files
afconvert	Convert AFF$raw or AFF$AFF
afxml	Output AFF metadata as XML
aftest	Validate the AFF Library

- These tools work under FreeBSD, Linux, OS X.
- Available at: http://www.afflib.org

AFF support

- AFFLIB stream abstraction makes it easy to add AFF support to existing programs.

```
AFILE *af;

af = af_open(filename,O_RDONLY,0666);
af_seek(af,offset,whence);
af_read(af,buf,count);
af_write(af,buf,count);
af_close(af);
```

- Support has been added to The Sleuth Kit.

Storing metadata in AFF

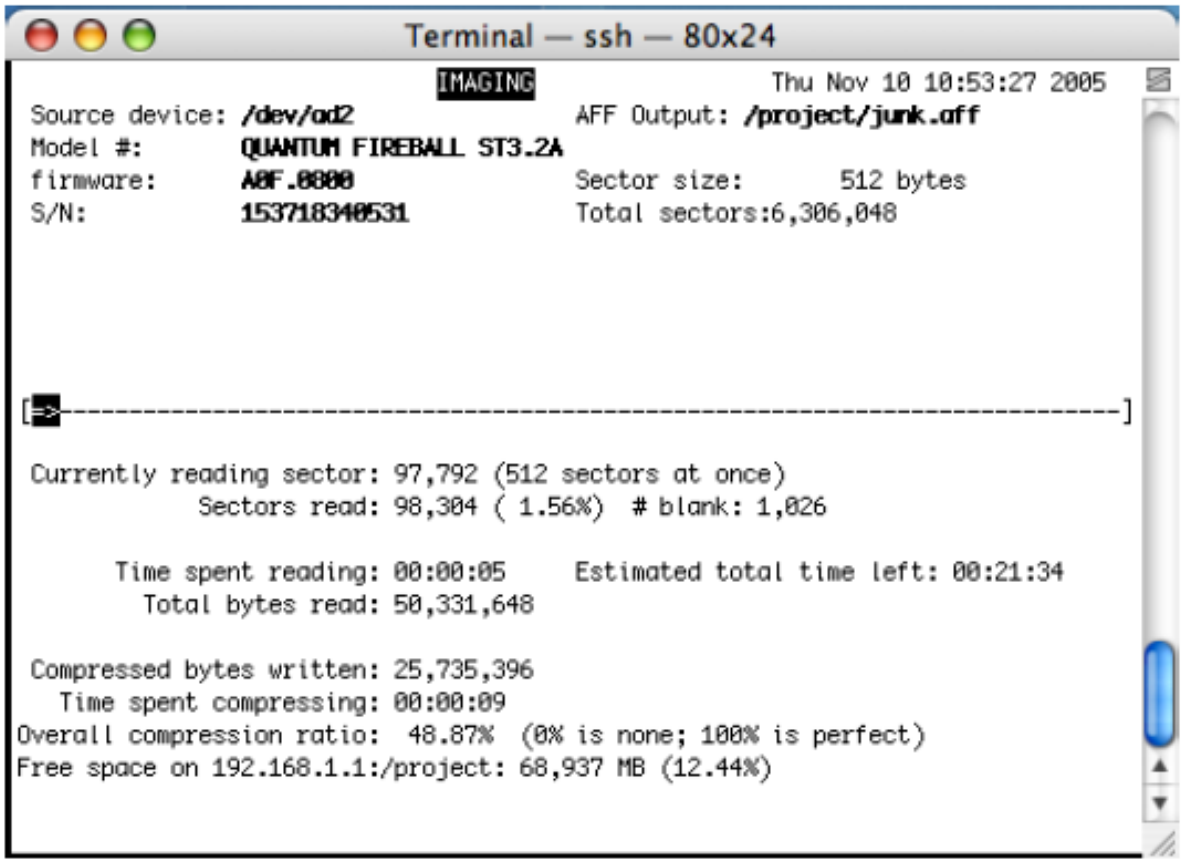
- AFFLIB put/get routines make it easy for programs to read and write metadata.

```
AFILE *af;
char *name;
int arg;

int af_get_seg(af,name,arg,data,datalen);
int af_get_next_seg(af,name,arg,data,datalen);
int af_rewind_seg(af);
int af_update_seg(af,name,arg,value,vallen,add);
int af_del_seg(af,name);
```

AImage

- AImage is the Advanced Disk Imager tool in AFFLIB.



AImage features

- Writes AFF and/or raw (dd)
- Automatically reads drive SN and other drive metadata
- Compress during imaging or afterwards
- MACs & signatures for segments and/or image
- Intelligent error recovery
- Bad Block Markup
  - Bad sectors are stored as “BAD SECTOR” and random data.
- Works on Linux and FreeBSD

Bad sector example

- Example: AFF file of a bad disk (acquired with aimage):

Segment	file offset	arg	data length	data preview
badflag	8	0	512	BAD SECTOR.%...p.l.r.P1W(e6....
badsectors	551	2	8	= 6144 (64-bit value)
pagesize	593	16777216	0	
imagesize	624	2	8	= 853622784 (64-bit value)
device_model	665	0	11	WDC AC2850F
device_sn	712	0	15	WD-WT3130627676
device_firmware	760	0	8	28.25E40
cylinders	807	1654	0	
heads	840	16	0	
sectors/track	869	63	0	
device_capabilities	906	0	758	.Protocol ATA/ATAP
imaging_commandline	1707	0	37	aimage -z ata1 /project3/affs/9
imaging_device	1787	0	8	/dev/ad2
image_gid	1833	0	16	..-..I2s6..0...P
imaging_date	1882	0	19	2006-01-06 11:45:14
page0	2028	1	81994	x....N....a.iT:Sd.....R.bR.T ..
blanksectors	84050	2	8	= 11 (64-bit value)
page50	84094	1	82003	x....N....P.IT:Sd..I..... ..\2

Future: Sector Annotations

- Motivation:
  - Many acquisition tools write all zeros when bad sectors are encountered
  - Makes it difficult to know a sector is all zeros because it was wiped or it was bad…
  - Data on a disk may need to be redacted before it is given to someone else:
    - *Clearance levels*
    - *Contraband*
- AFF will maintain annotations for every sector:
  - Not read (did not get a chance to read before acquisition was aborted)
  - Read
  - Bad
  - Redacted

Future: AFF Consortium

- Goal is to involve others with the design and development
- Consortium membership will help to define the AFF schema and standards
- E-mail info@basistech.com for more information

Summary

- AFF is an open and extensible format for storing digital evidence
  - Arbitrary metadata can be stored
  - Several storage formats exist for different needs
- LZMA compression allows smaller disk images to be created for transport
- AFM and AFFXML allow acquired data to be used with tools that support raw images
- AFFLIB allows AFF to be easily incorporated into existing tools

Questions?

www.afflib.org

www.basistech.com/digital-forensics/aff.html