Deleted File Recovery Tool Testing Results

Jim Lyle

NIST

CFTT

- Develop specifications for testing forensic tools
  - Disk Imaging
  - Write Blocking
  - Drive erase for reuse
  - Metadata based deleted file recovery
  - Other specs in development
- Submit test reports to NIJ for publication ~90

Deleted File Recovery

- Deleted file recovery (DFR)
  - Metadata based (from directory, i-node, MFT, etc.) – now
  - Signature based (aka file carving) – next
- Tested six popular tools
- Test reports are being drafted for publication later this year

Talk Goals

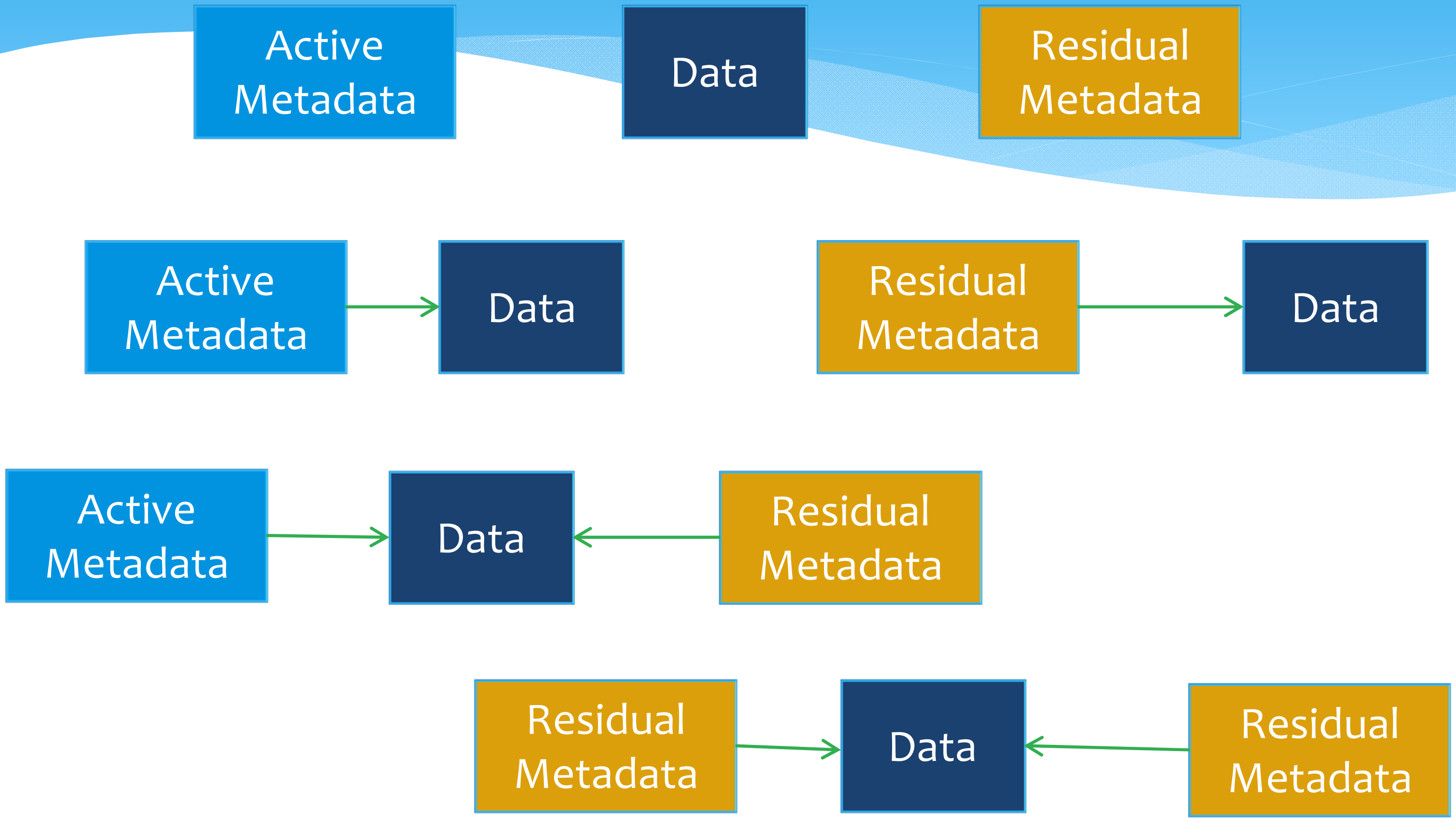
The presentation will impact the forensic community by:

- increase awareness in the community of ability of tool testing to reveal anomalies in tool behavior
- help the forensic practitioner recognize tool limitations

Remainder of Talk

- Metadata relationships
- Test suite
- Identifying Supported file systems
- Consider if there is fragmentation, but intact
- Overwriting
- Chaos
- Summary

Metadata relationships with data



Active Metadata

Data

Residual Metadata

Active Metadata → Data

Residual Metadata → Data

Active Metadata → Data ← Residual Metadata

Residual Metadata → Data ← Residual Metadata

17 BaseTest Cases

DFR-01. Recover one non-fragmented file.

DFR-02. Recover file with two fragments.

DFR-03. Recover file with multiple frags.

DFR-04. Recover files with non-ASCII names.

DFR-05. Recover several fragmented files.

DFR-06. Recover one large file.

DFR-07. Recover one overwritten file.

DFR-08. Recover several overwritten files.

DFR-09. Recover 1000 files no overwrite.

DFR-10. Recover 1000 files, overwritten.

DFR-11. Recover one directory.

DFR-12. Recover multiple directories.

DFR-13. Recover random activity.

DFR-14. Recover other file system object.

DFR-15. List one of each object.

DFR-16. List a large number of files.

DFR-17. List deep file paths.

At least 4 images per case:

1. FAT: FAT12, FAT16 & FAT32
2. ExFAT
3. NTFS
4. EXT: ext2, ext3 & ext4

Some one-off images:

- NTFS compressed
- NTFS file in MFT
- HFS+ file listing
- Recycle bin/trash can

Supported File Systems

Determine supported file systems by trying a simple case –

Delete a single file, see if the six tools recovers anything

FS	1	2	3	4	5	6
ext2	✔	✔	✔	✔	✔	✔
ext3						
ext4						
FAT	✔	✔	✔	✔	✔	✔
NTFS	✔	✔	✔	✔	✔	✔
ExFAT	✔	✔	✔			✔
HFS+						

FAT Fragmentation

Case FAT-03 -- Recover a file in 4 fragments

Layout: A, C, D & E are active files; B is deleted

A	B1	C	B2	D	B3	E	B4

Results:

- Three tools recovered entire file
- One tool stopped after first cluster
- One tool included part of an active file
- One tool recovered two fragments and two clusters from active files

Tool	Recovered File			
1	B1	B2	B3	B4
2	B1			
3	B1	C(1)		
4	B1	B2	B3	B4
5	B1	B2	B3	B4
6	B1	C	B2	D

Fragmentation – Other File Systems

- NTFS – Well behaved
- Ext2 – recovered where supported
- One tool had trouble with ext2

FS	1	2	3	4	5	6
FAT	✔	1	1A	✔	✔	2AM
ExFAT	✔	✗	✗	□	□	✔
NTFS	✔	✔	✔	✔	✔	✔
ext2	2	✔	✔	✔	✔	✔

□ -- not supported
✗ -- not recovered
✔ -- recovered
Other – partial recovery

Summary for non-overwriting Cases

# recovered / # deleted						
FS	1	2	3	4	5	6
FAT	807/819	792/819	792/819	807/819	807/819	792/819
ExFAT	270/273	254/273	265/273	□	□	270/273
NTFS	273/273	273/273	273/273	273/273	273/273	273/273
ext	264/273	273/273	273/273	255/273	273/273	271/273

- Best results on NTFS, all files recovered by all tools
- Some tools miss a few files from ext2
- All tools miss a few files from ExFAT

Anomalies for non-overwriting Cases by data source

# multi-src / # other src / # Active file						
FS	1	2	3	4	5	6
FAT	9/0/0	6/0/0	27/3/18	9/0/0	12/0/3	24/0/18
ExFAT	0/0/1	10/0/10	8/0/8	□	□	0/0/0
NTFS	0/0/1	0/0/0	23/0/23	0/0/0	0/1/0	0/0/0
ext2	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0	0/0/0

- Except for one file recovered by tool #5, and 3 recovered by tool #3, all recovered content came for current or previous files
- Tool #3 recovered 296 of 273 deleted NTFS files

Overwrite Cases: Data & Metadata

Available Metadata and File Block Summary

		Metadata Exists			Metadata Overwritten		
Case	**Deleted**	**Intact**	**Partial**	**None**	**Intact**	**Partial**	**None**
FAT	2894	1118	2	100	7	10	1657
ExFAT	965	376	3	28	1	3	554
NTFS	965	371	3	560	0	3	28
EXT	2869	1225	21	969	17	8	629

Summary for Overwriting Cases

# intact files with metadata / # deleted						
FS	1	2	3	4	5	6
FAT (1118/2894)	885	885	885	885	885	885
ExFAT (376/965)	369	275	305	□	□	370
NTFS (371/965)	374	374	353	374	374	374
Ext (408/956)	292	372	372	14	372	372

- Best results on FAT & NTFS
- One tool showed poor results for ext2
- Results for ExFAT vary

Anomalies for overwriting Cases by data source

# multi-src / # other src / # Active file						
FS	1	2	3	4	5	6
FAT	304/4/41	183/3/41	309/66/170	269/3/0	269/3/40	297/81/197
ExFAT	18/14/16	95/7/94	89/10/88	---	---	18/18/16
NTFS	24/2/24	21/24/0	29/0/29	21/14/6	24/2/24	24/0/24
ext2	107/52/9	25/26/0	431/17/426	16/8/17	29/56/162	29/17/24

- Lots of recovered files include data from more than one source
- NTFS seems best behaved

Summary

- The residual metadata varies with the file system. For example, file names may be completely or partially lost, pointers to file blocks may be overwritten.
- Only the first block of a deleted file is identified for FAT file systems. Some tools guess the location of the remainder of the deleted file; this strategy often leads to recovered files that are mixed from several original files.
- The tools sometimes include blocks from active files in a recovered file.
- The tools rarely include blocks that have never been allocated to the current file system, i.e., it is not likely that a block from a recovered file was not a part of some file.
- Some tools attempt to identify overwritten files. The tools often identify (incorrectly) intact files as overwritten.
- Support for ExFAT, ext3 and ext4 is sometimes lacking.

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Contact Information

Jim Lyle
jlyle@nist.gov
http://www.cftt.nist.gov
http://www/cfreds.nist.gov

Sue Ballou, Office of Law Enforcement Standards
Steering Committee representative for State/Local Law Enforcement
Susan.ballou@nist.gov