Microsoft Office Upload Center Cache Files in Forensic Investigations

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Overview - Definition of cache files

- Microsoft Office Cache Files: generated by Microsoft Office Upload Center.
- Path: `\Users\<USERNAME>\AppData\Local\Microsoft\Office\<VERSION>\OfficeFileCache`
- File format list:
  - **FSD-files**: used to store the document
  - **FSF-files**: used as a connecting point between the FSD-file and CentralTable.accdb
  - **CentralTable.accdb**: used to store all metadata regarding the upload process

Overview (cont.)

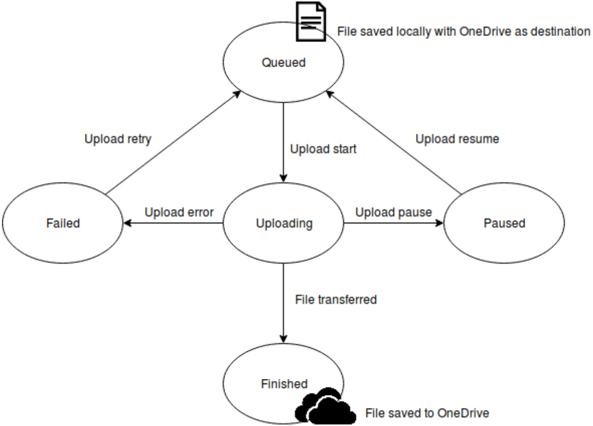


Figure 1: States of cache files during the upload process to OneDrive

Problem Statement & Research Question

- Only **speculation** on what forensic value the FSD- and FSF- files have
- “**1.2 Billion** Microsoft Office Users and **200 Million** OneDrive users in 2014” [1]

Research Question

In what way do the cache files produced by Microsoft Office Upload Center contribute to a forensic investigation?

[1] Microsoft by the Numbers: https://news.microsoft.com/bythenumbers/planet-office

Related Work

1. Cloud Hosted Data in Digital Forensics (Slidedeck - 2014):
    - Australian technology company called **Nuix**
    - Briefly described the global contents of **CentralTable.accdb**
2. Windows 10 Forensics - OS Evidentiary Artefacts (Slidedeck - 2015):
    - Australian Researcher **Brent Muir**
    - Manually carve document from **FSD-files** but no methodology published

Methods

- Generate dataset:
  - cache files in all five states
  - two users on a Windows 7 VM running Microsoft Office 2016
  - .pptx, .docx, and .xlsx to upload: empty, large (5MB) and with one line of text (with & without an image)
- Perform statistical analysis: determine what information is available and what not under what circumstances
- Derive unknown file formats: length, offsets, known file headers, number of files, and checksums in data sections

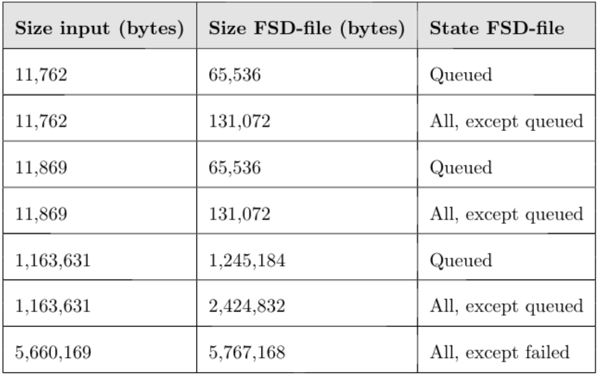
Results

Results outline:

1. File description
2. Availability of information
3. Retrieved data implication

File Description - FSD-file

- The size of an FSD-file differs depending on the size of a source document



Size input (bytes)	Size FSD-file (bytes)	State FSD-file
11,762	65,536	Queued
11,762	131,072	All, except queued
11,869	65,536	Queued
11,869	131,072	All, except queued
1,163,631	1,245,184	Queued
1,163,631	2,424,832	All, except queued
5,660,169	5,767,168	All, except failed

Table 1: Examples of differences between file sizes of input documents and FSD-files per state

File Description - FSD-file (cont.)

- Global file format derived from comparisons
- FSD-file:
  - Magic Header (16 bytes)
  - Unknown data (8176 bytes)
  - Subsection (appearing α times):
    - Header A (8 bytes)
    - Unknown data (β bytes)
    - Header K (8 bytes)
    - Optional Section Q (appearing γ times)

File Description - FSD-file (cont.)

- Optional Section Q:
  - Header Q (8 bytes)
  - Data (Unknown bytes)
  - End of data header Q - 79 05 (2 bytes)

- Data: Contains ZIP-archive headers and image headers
- Implies (part of) Office document is in the FSD-file

File Description - FSF-file

- The file format of the FSF-file:

Header (20 bytes)	
α: Data Length (1 byte)	*Data*: Filename & Terminator(*0x05*) (α bytes)
Total Size: 21 bytes + Data Length	

- FSF-file points to FSD-file name: Used by CentralTable to connect metadata in CentralTable to FSD-file

File Description - CentralTable.accdb

- Microsoft Access database (Date/time unreadable) [2]
- Metadata about documents submitted to Microsoft Upload Center
- It consists of the following tables:
  1. MasterFile
  2. CacheProperties
  3. IncomingEvents
  4. OutgoingEvents
  5. ServerTarget

[2] https://github.com/rickvg/office-cachefiles

File Description - CentralTable.accdb (cont.)

- Table **MasterFile** contains most metadata:
  - Pointer to the FSF-file (*FileEntryFileID*)
  - Name of the file
  - Author of the file
  - E-mail address of uploader
  - Remote location of file (If uploaded)
  - Dates and times: Modified and Uploaded (Server & Local)

Availability of Information

- Our CentralTable parser shows old rows in table *MasterFile* [3]
- CentralTable: Count of rows per state increases for table *MasterFile*

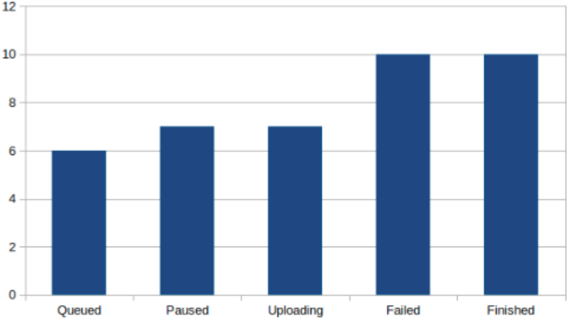


Figure 2: Mean count of rows per state for table *MasterFile*

[3] https://github.com/rickvg/office-cachefiles

Availability of Information (contd.)

- Generic changes during state transitions:
  - Tables *MasterFile* and *CacheProperties* change the revision number in column **ColumnRevisionID**
- MasterFile-table changes during state transitions:
  - Most changes
- CacheProperties-table changes during state transitions:
  - No patterns found

Availability of Information - Document Recovery

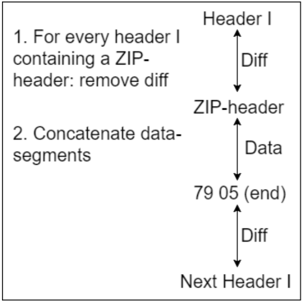
- Document recovery from cache files:
  - Manual or Automatic
  - With or without Microsoft Office 2016

Availability of Information - Document Recovery (contd.)

- Automatic with Microsoft Office 2016
  - CentralTable requires records for uploading a file
  - Column *FileEntryID* in table *MasterFile* must point to FSF-file GUID
  - Column *FFileSavedToServer* in table *MasterFile* must be set to 0
  - FSF-file can be generated for any FSD-file
- Recover full document including its images and metadata

Availability of Information - Document Recovery (contd.)

- Manual or automatic without Microsoft Office 2016
- Extraction script for small documents and parts of large documents [4]



1. For every header I containing a ZIP-header: remove diff

2. Concatenate data-segments

Figure 3: Extraction method for small documents without images

[4] https://github.com/rickvg/office-cachefiles

Retrieved Data Implication

- In our research, the retrieved data is divided into two parts:
  - (Parts of) original documents
  - Metadata related to documents
- Additional evidence in a forensic investigation [5]

[5] http://ieeexplore.ieee.org/document/7379751/

Conclusion

- **FSD-file** is used to store the document, **FSF-file** is used as a connecting point between the FSD-file and CentralTable.accdb and **CentralTable.accdb** is used to store all metadata regarding the document
- (Parts of) documents and its own metadata can be retrieved from FSD-files
- Check whether entries in table *MasterFile* have been manipulated (not which)
- The large amount of metadata with(out) the document could be used as additional evidence in a forensic investigation

Future Work

- Exploring the FSD-file format in more details
- Extending **FSD-files Documents Extractor** script to support large-size documents and documents including images
- Expanding the research to include various **Microsoft Office versions**, **Operating Systems**, and **file-hosting** cloud platforms

The End

Thank you for your attention

Do you have any questions?