# OSForensics

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# 1 Introduction and Overview

PassMark OSForensics is a powerful, comprehensive forensics tool for discovering, identifying and managing digital evidence that is found in computer systems and digital storage devices. OSForensics is organized into a collection of modules for simplifying the task of analyzing the vast amounts of data on live systems and storage media with a simple, easy-to-use modular interface. Such modules include a File Name Search module which can identify evidence material by file name in seconds, as well as more sophisticated module such as a Deleted File Search module for identifying harder to locate digital evidence artifacts.

For a summary of the included modules and functionality, see the Features page.

# 2 How to Purchase OSForensics

With the release of OSForensics V8, PassMark has introduced a subscription option. The licensing option best suited to you will depend on your use case, how frequently you use the software and your need to access the latest updates and user support.

**Subscription License**
Monthly: $79.00 USD
Yearly: $799.00 USD

**Perpetual License**
OSForensics, including 12 months of Support and Updates: $1499.00 USD
OSForensics, including 36 months of Support and Updates: $3299.00 USD

See here for license inclusions and a detailed license comparison.

Purchase Online Here

Discounts apply when ordering 5 or more copies at once.

## What happens when you order

After the order is processed, a License Key will be returned (via E-Mail). This Key is then entered with the User Name into the initial window. At this point the program then changes into the full licensed version.

### Unlocked advanced features

- Search for alternate file streams.
- Sort found files by image color.

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- Use multiple processor cores to speed up decryption.
- Customize system information gathering.
- Import / Export Hash Sets
- Maximum of 3 cases limitation is removed
- Maximum of 10 items per case limitation is removed
- Maximum of 10 user activity items allowable to be exported is removed.
- Maximum of 2,500 files and emails allowable to be indexed is removed.
- Maximum of 250 index search results limitation is removed.
- Maximum of 5 login details per browser limitation is removed.
- Restore multiple deleted files at once.
- View NTFS $I30 directory entries.
- Watermark in web browser screen capture is removed.
- Bootable without an operating system.

## Confidentiality

All personal details supplied when placing an order will be strictly confidential. Online orders will only be accepted over a secure, encrypted connection.

## Multi-user & Site Licenses

Please contact us for details if you require multi-user or site licensing for your organization.

## Questions & more information

If you have any questions we would be happy to hear about them. Contact

sales@passmark.com

# 3 Navigating OSForensics

OSForensics is organized into multiple feature modules for discovering, identifying and managing digital forensics artifacts.

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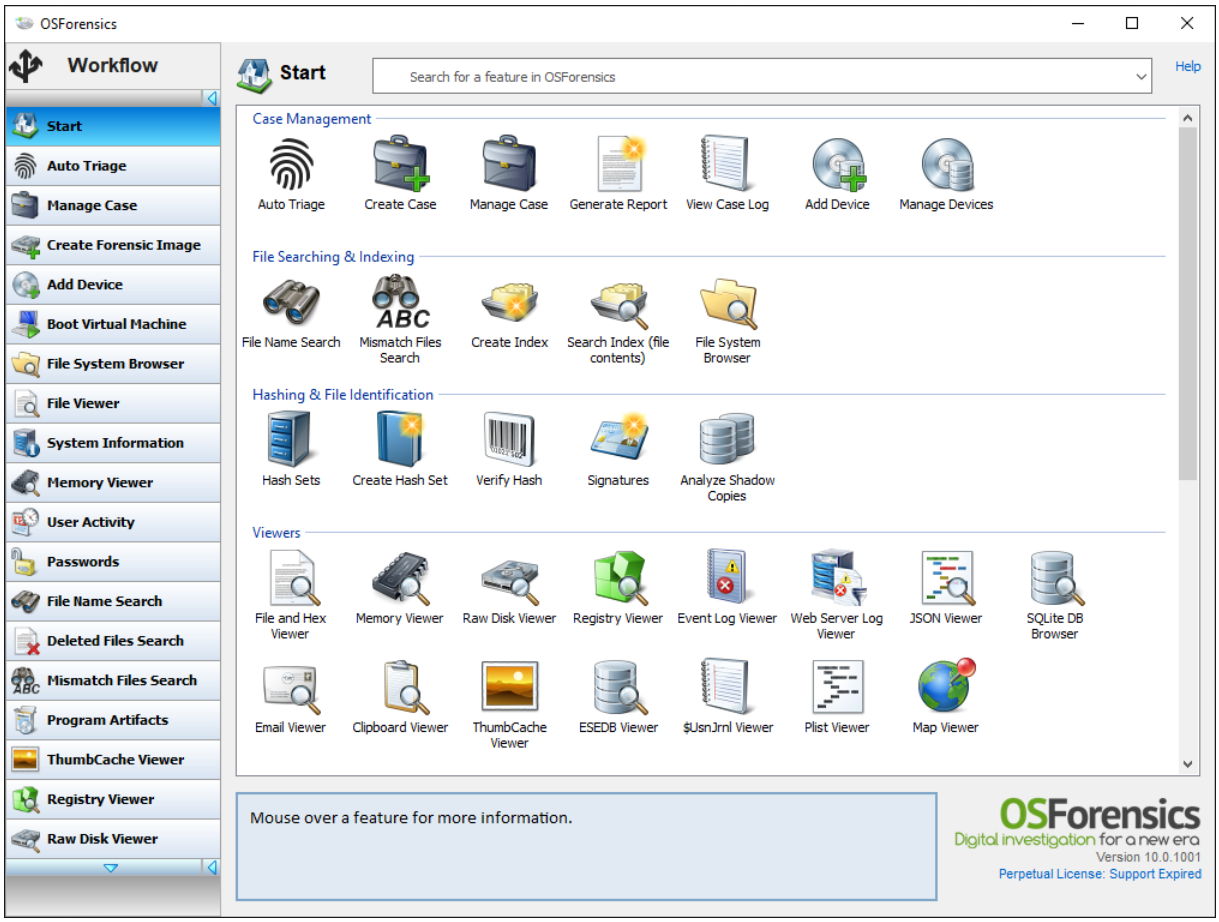


The start window contains a brief description of each feature on mouse over. A green pulsating light appearing next to the sidebar button means that the module is currently performing a task. A blue light means that a task has been completed.

The *Workflow* navigation buttons on the left side of the window allows the investigator to switch between multiple modules simultaneously, allowing forensic analysis operations to be performed in parallel. The order of the navigation buttons in the Workflow can be customized to reflect the chronological order of the organization's forensic workflow. The workflow order can by customized by right-clicking any navigation button and selecting *Customize Workflow*. Alternatively, there is a *Customize Workflow* icon under the *Housekeeping* group in the *Start Window*.

## Customize Workflow

This window allows you to re-arrange the navigation buttons that appear in the Workflow menu on the left side of the OSForensics window, as well as the icons that appear in the *Start Window*.

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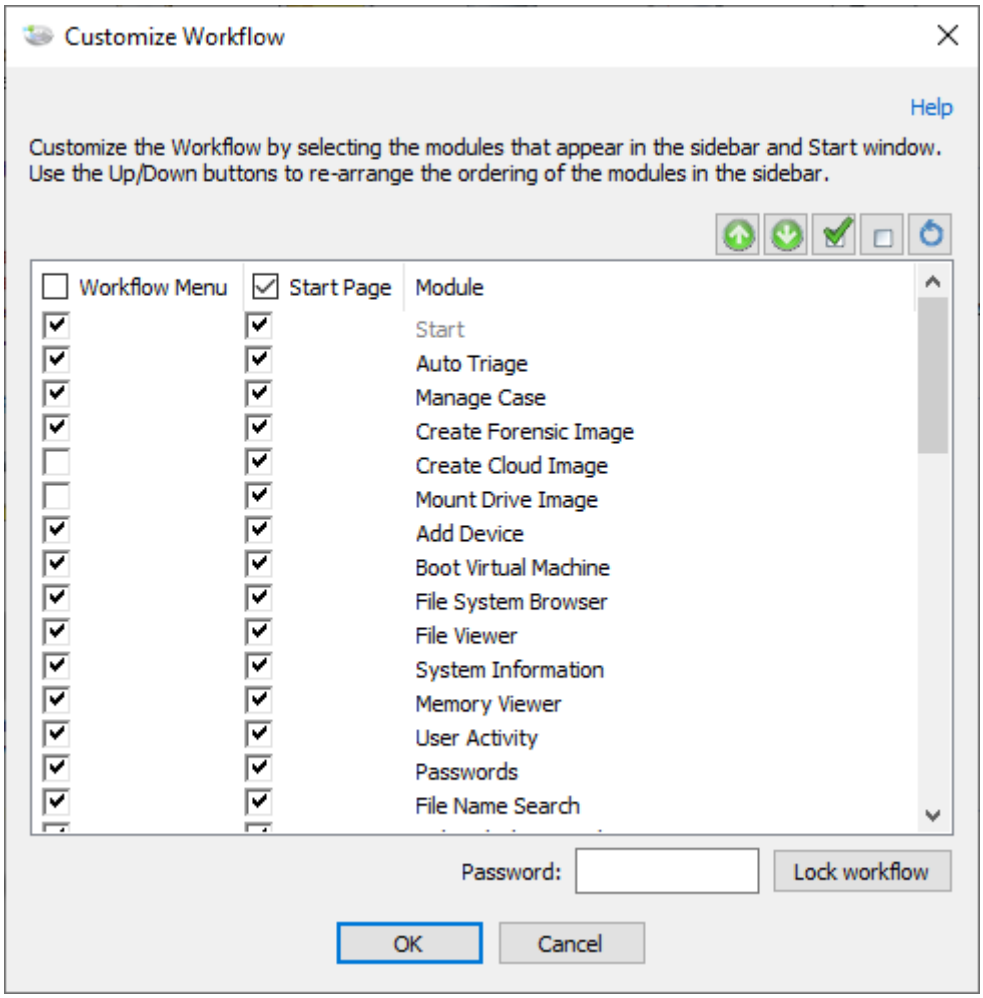


By entering a password and clicking *Lock workflow*, you can deter end users from changing the workflow and accessible options in the *Start Window*.

To unlock the workflow, simply re-enter the password and click the *Unlock workflow* button.

Note that this feature is only designed to act as a deterrent from allowing end users (such as field agents) to use particular features. It does not ensure the disabled features can not be accessed. The lock can be manually removed by clearing the setting in the XML configuration file.

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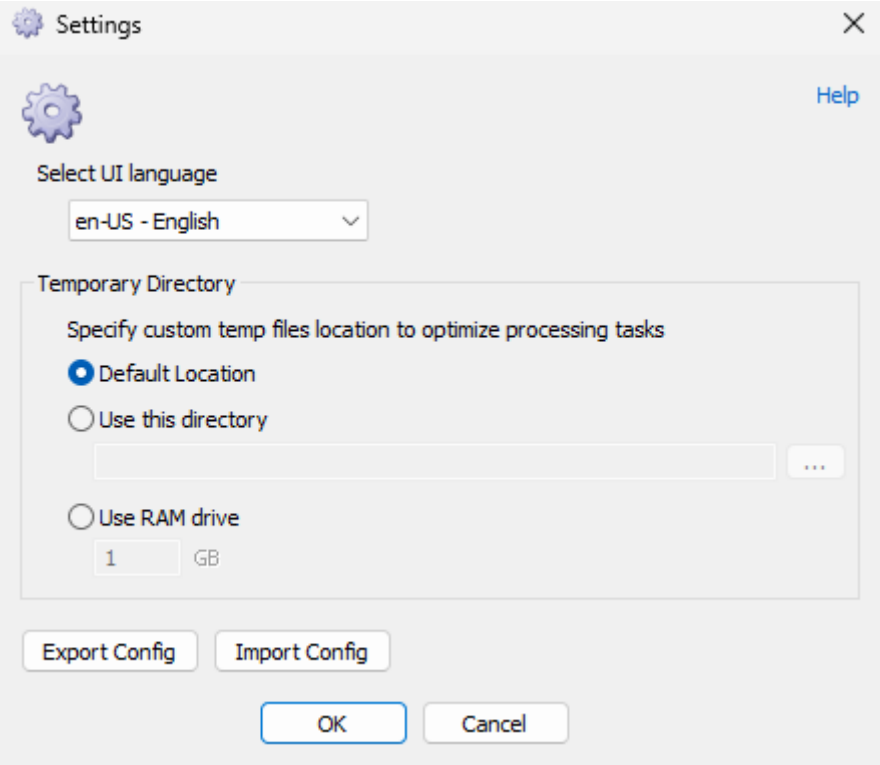
# 4 OSForensics Settings




**UI Language**
Select the UI language in use. After changing OSForensics will be required to restart to apply the selected language.

**Temporary Directory**
Specify the directory to store temporary files. OSForensics will create temp files in the specified location.

**Export/Import Config**
Export/Import OSForensics settings to/from a file.

# 5 Features

OSForensics contains a collection of modules for searching, collecting, analyzing and recovering digital artifacts that can be used as legal evidence in court. The main features of OSForensics are outlined as follows.

## Android Artifacts

Scan Android case devices and backups for evidence of user activity, such as accessed call logs, websites, messages, and contacts.

## Auto Triage

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Automate common forensic tasks in order to triage the most relevant evidence data in time-limited situations. Auto Triage allows non-forensics trained personnel to acquire intelligence on-site which can be volatile and high-risk.

### Boot Virtual Machine
Boot a disk image containing a functional operating system on a virtual machine, recreating the live desktop environment of the system of interest.

### Case Management
Manage evidence obtained from OSForensic modules into a single *Case.* Generate HTML and PDF reports to summarize forensic analysis results.

### Clipboard Viewer
Display the contents stored in the clipboard on the live system, including the clipboard history and pinned items if available.

### Deleted Files Search
Search for and recover files that have been recently deleted from the hard drive.

### Drive Preparation
Perform byte pattern verification tests on fixed and removable drives attached to the system.

### Email Viewer
Browse and analyze e-mail files including orphaned and deleted e-mails.

### ESE Database Viewer
Navigate and search the tables, fields and records contained within ESE database files. Various Microsoft applications including Windows Search and Microsoft Exchange Server store data with potential forensics value in the ESE database file format.

### Event Log Viewer
View Windows Event Logs. Scan, search, filter, export and time-line analysis can be performed on the Event Logs.

### File Name Search
Search for files/directories based on name and other file attributes such as size, attributes, and time.

### File System Browser
Display the file system of all devices added to a case in an explorer-like view. In addition to standard file system attributes such as file size and file times, other forensic-related metadata is displayed.

### Forensic Imaging
Create exact, bit-by-bit duplicates of a disk into an image file. Restore an image file back to the disk. Create a forensically sound logical image of files/directories of interest, preserving file dates, attributes and owners.

### Hash Sets
Identify known safe or known suspected files using *Hash Sets* to reduce the need for further time-consuming analysis.

### Image Analysis
Performs deep learning image analysis on image files for face detection or illicit image detection.

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### Indexing
Scan and search for text strings within the contents of a file. Also capable of searching within email archives and pulling text out of unallocated disk sectors.

### Internal Viewer
View and analyze files within OSForensics without needing to open an external application. This can be used for files in devices added to the Case such as disk images, which cannot be opened normally in the operating system.

### Map Viewer
Search, import and plot location-based evidence on a world map. This includes IP addresses in e-mail headers and server logs, and GPS coordinates in EXIF metadata.

### Memory Viewer
Collect and analyze digital evidence in volatile memory storage. Due to the non-persistent nature of memory, some digital evidence may only be available on a live system.

### Mismatch Search
Identify files that may show evidence of tampering due to having a file extension that is different from what the contents of the file suggests. Eg. A .jpeg file renamed to a .txt file.

### Passwords
Recover and decrypt passwords from various sources.

### Plist Viewer
View the contents of Plist (property list) files which are commonly used by OSX and iOS to store settings and properties.

### Program Artifacts
Collect traces of Prefetch and AmCache hive artifacts left by applications. The Prefetch Viewer displays the information stored by the operating system's Prefetcher, which includes when and how often an application is run. The AmCache Viewer shows information from the AmCache hive that contains meta information on program executables and installation.

### Raw Disk Viewer
Open and view raw sectors of a disk. Data hidden in the sectors outside the file system can be identified and analyzed with this module.

### Registry Viewer
View Windows Registry Hives, including the live system where files can be locked / in use

### Signatures
Create a snapshot of a system's directory structure at specific point in time using *Signatures*. *Signatures* can be compared in order to identify files that have been added, deleted and changed.

### SQLite Database Browser
Navigate and search the tables, fields and records of SQLite database files.

### System Information
View and export hardware, platform and operating system details which can be used for evidence inventory management.

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### ThumbCache Viewer
Extract thumbnail images stored in Windows' thumbnail cache files for viewing. Thumbnail cache files may contain evidence of images that have been deleted on the system.

### User Activity
Scan the system for evidence of user activity such as accessed websites, USB drives, wireless networks, and recent downloads.

### Verify/Create Hash
Create hashes (SHA1, MD5, CRC32) of files or entire hard disk.

### Web Browser
Provide a basic web viewer with forensics capabilities. This includes the ability to save screen captures of web pages and add them to the currently opened case.

### Web Server Log Viewer
Extract and analyze log data generated by Apache, IIS, NGINX or other custom web server logs.

### $UsnJrnl Viewer
View the log records stored in the NTFS $UsnJrnl volume change journal. This information is useful for identifying suspect files (eg. malware) that no longer exist in the file system or $MFT.

## 5.1 Android Artifacts

This module allows an investigator to scan case devices and backups for evidence of user activity such as call logs, SMS and MMS messages, and contacts.

In order for the phone to be able to run the OSFExtract app, the Android device under investigation must but be running at least Android 8.0 or newer (API level 26 or higher).

The Android Artifacts module is reachable via the "Android Artifacts" icon on the start screen.

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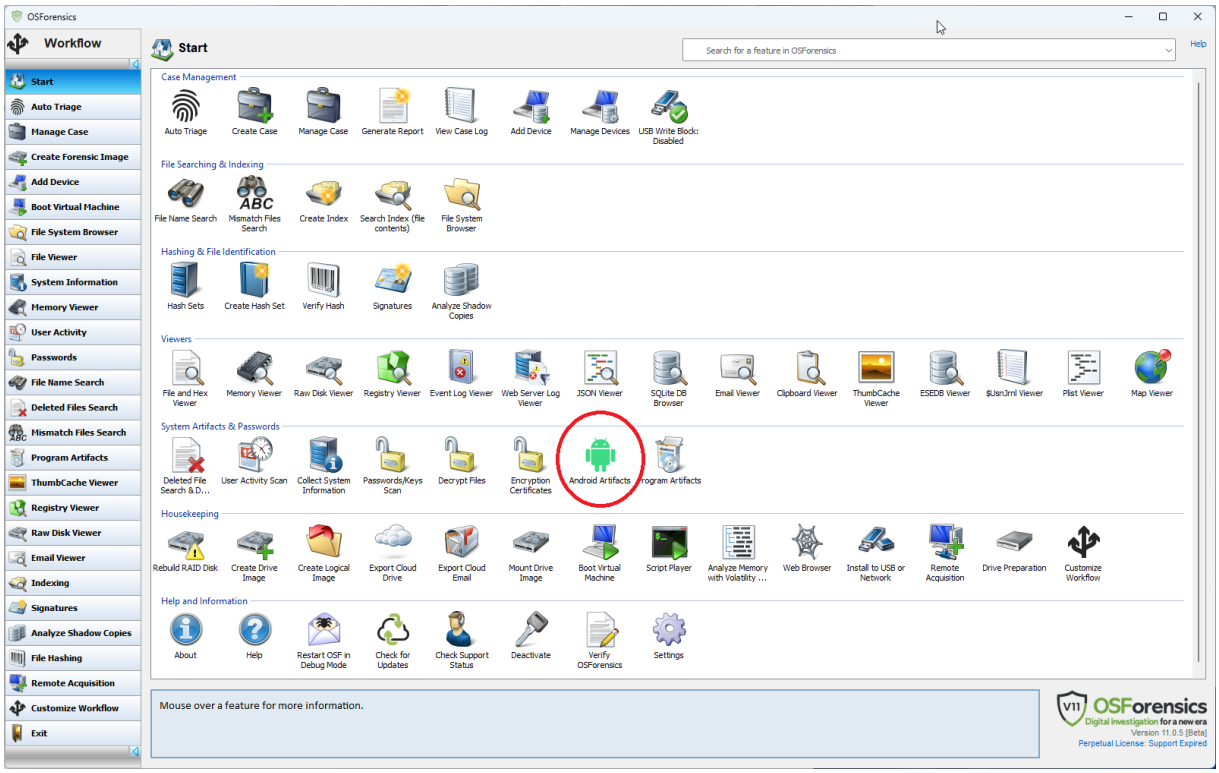
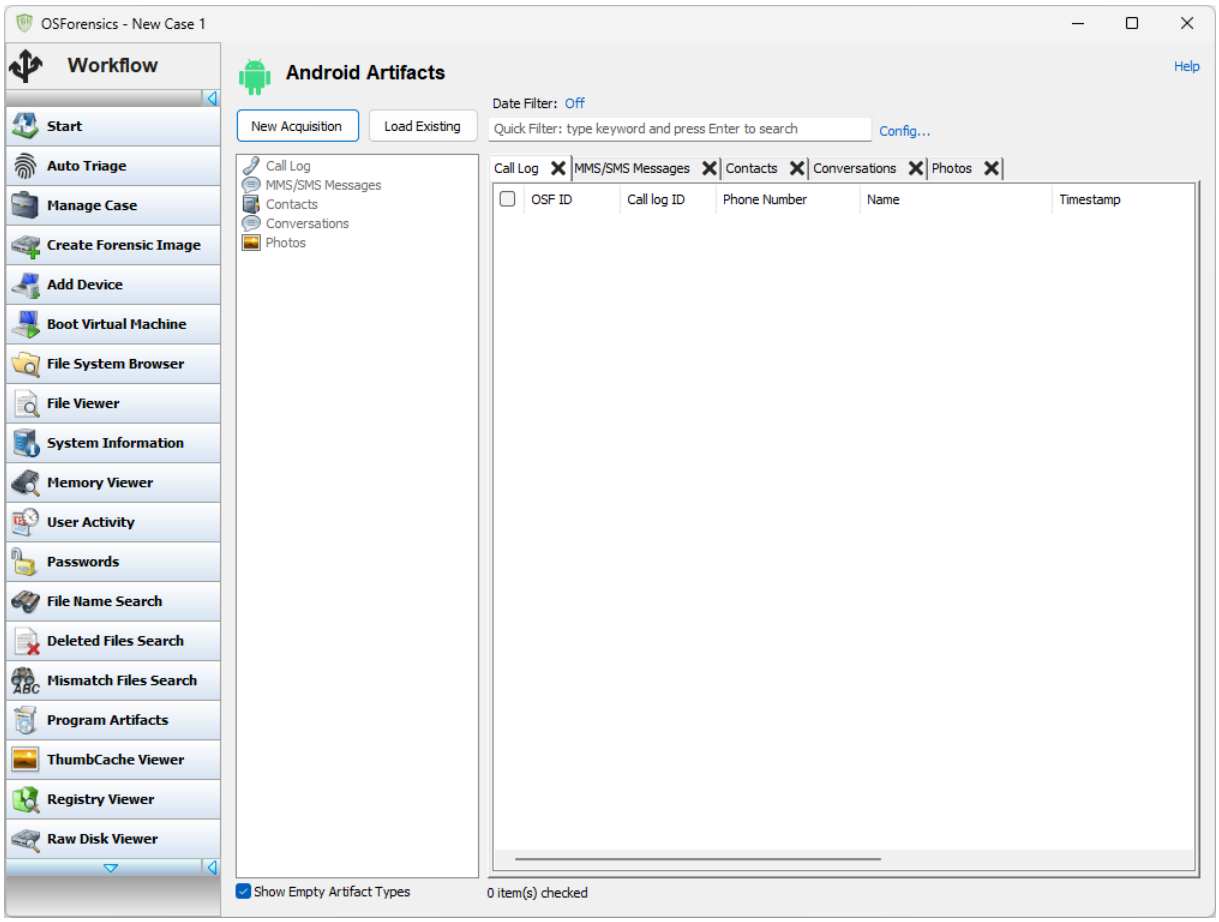



## Acquiring Android Data

The Android investigation process consists of two stages:

- acquiring the Android data which the user can initiate using the "New Acquisition" button which starts the "Android Acquisition Wizard"
- analyzing the Android data which the user can initiate by either
  - continuing in the wizard after the acquisition
  - using the "Load Existing" button




The acquisition stage works by:

- allowing the user to choose a phone
- connecting to that phone and uploading OSFExtract, the PassMark app that queries the phone for data and transmits it back to OSForensics
- receiving all the data that OSFExtract sends back and saving it in a file called OSFExtract.xml which is created in either the VHD the user specifies on a directory specified by the user

Once the user has started the "Android Acquisition Wizard" the first stage of the wizard allows the user to:

- Choose whether they want to extract Call Logs, Contacts, SMS/MMS message using the OSFExtract app
- Choose whether they want to copy what files are accessible via the Android Debug Bridge (ADB)

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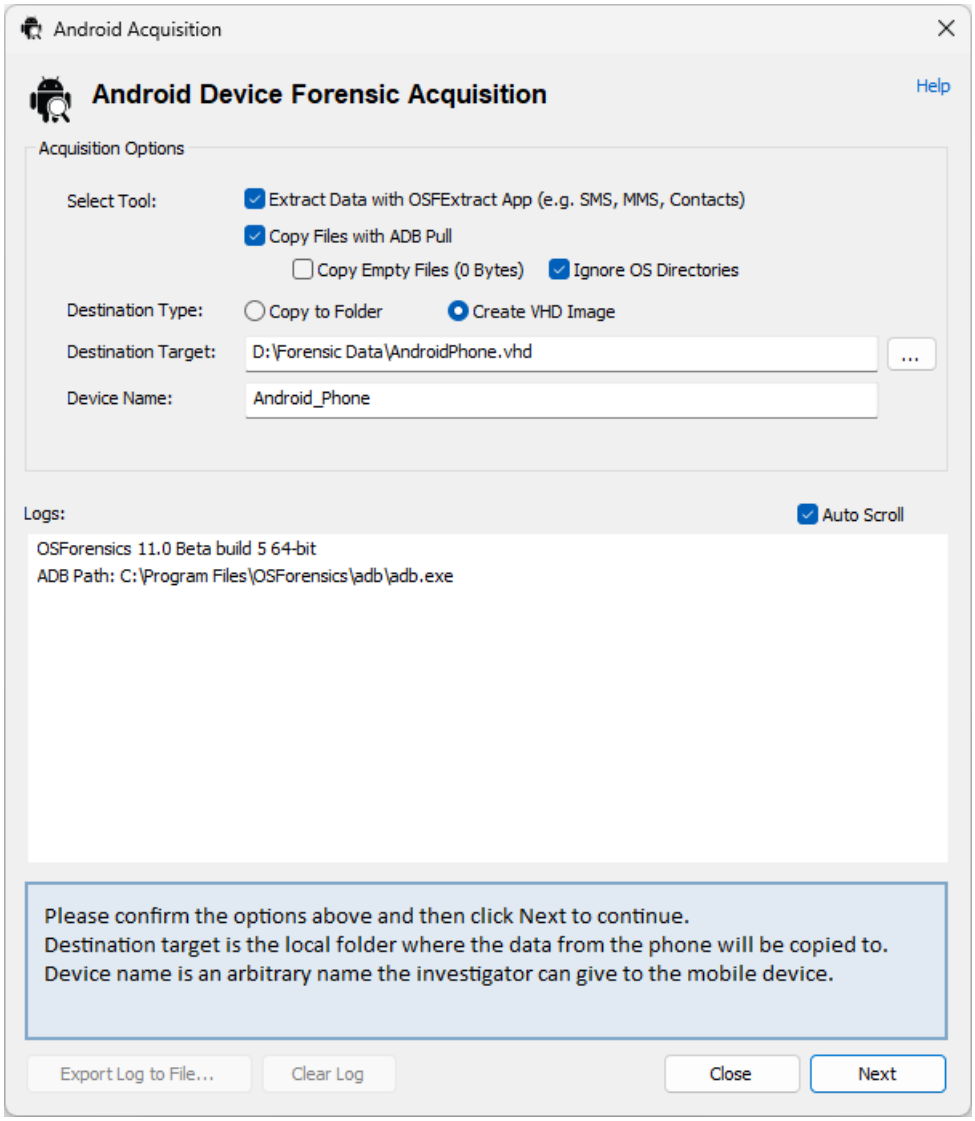


The user is also presented with a choice as to whether they would like the acquired data (be it via OSFExtract or ADB) is stored in a VHD image or in a directory.

The user must supply a location and name for the VHD or a location for the directory in which they want the acquired data to be stored.

The last piece of information required is the name by which to refer to the VHD or directory within the case at which point the "Next" button takes the user to the next stage of the wizard.

Here a list of all visible phones is presented to the user. It's important to note that just because a phone is connected to the PC it doesn't mean it's visible let alone accessible to OSForensics.

There are a few prerequisites for the phone to be accessible to OSForensics:

- the phone must be plugged into the PC. Not all USB ports are the same so if the phone never becomes visible, even after all the following steps, a different USB port may increase the likelihood of a connection.

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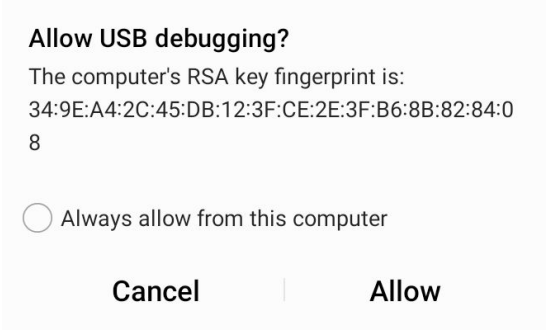
- the phone must be in Developer Mode (which is usually done by finding the build number in the "About" section in settings and clicking it 10 or more times). At this point the phone should become visible even though it will not be accessible to OSForensics.
- USB debugging must be on in settings and the user must have accepted USB debugging in the dialog box that Android presents whenver USB debugging is needed. It may be necessary to turn off USB debugging and turn it back on for Android to present the dialog box.




Once the phone being analyzed becomes "Connected" it's possible to select it and use the "Start" button to actually acquire the forensic data.

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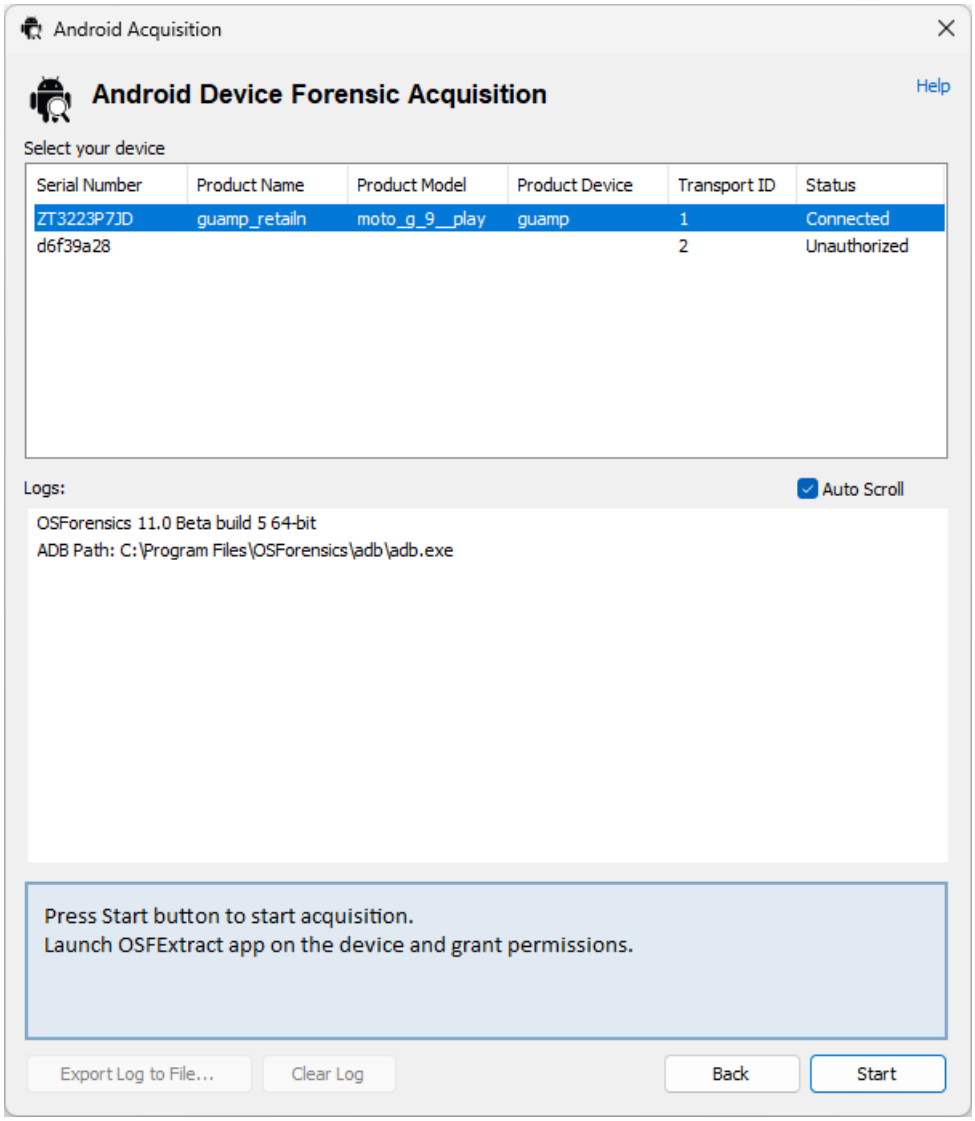


At this point OSForensics will, depending on what the user has requested, copy all possible files using ADB and acquire messages, contacts and call logs using OSFExtract, placing the resulting data in the location previously specified.

The user may be presented with a number of dialog boxes on the phone through which OSFExtract asks for the permissions it needs to query the forensic data on the phone.

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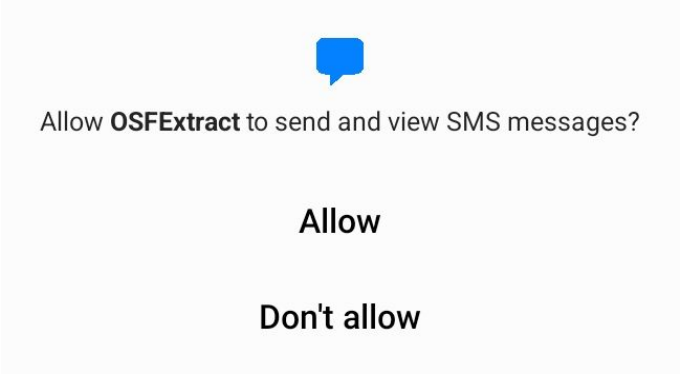


Each permission has as a corresponding lock icon on the OSFExtract screen for each of the types of data being collected:

- SMS/MMS messages and conversations
- Contacts
- Call logs

If a permission has not been granted the corresponding lock will indicate locked and red and that type of data will not be collected and sent back to OSForensics..

The wizard will display a dialog box with a summary of the progress of both the ADB copy and the OSFExtract acquisition.

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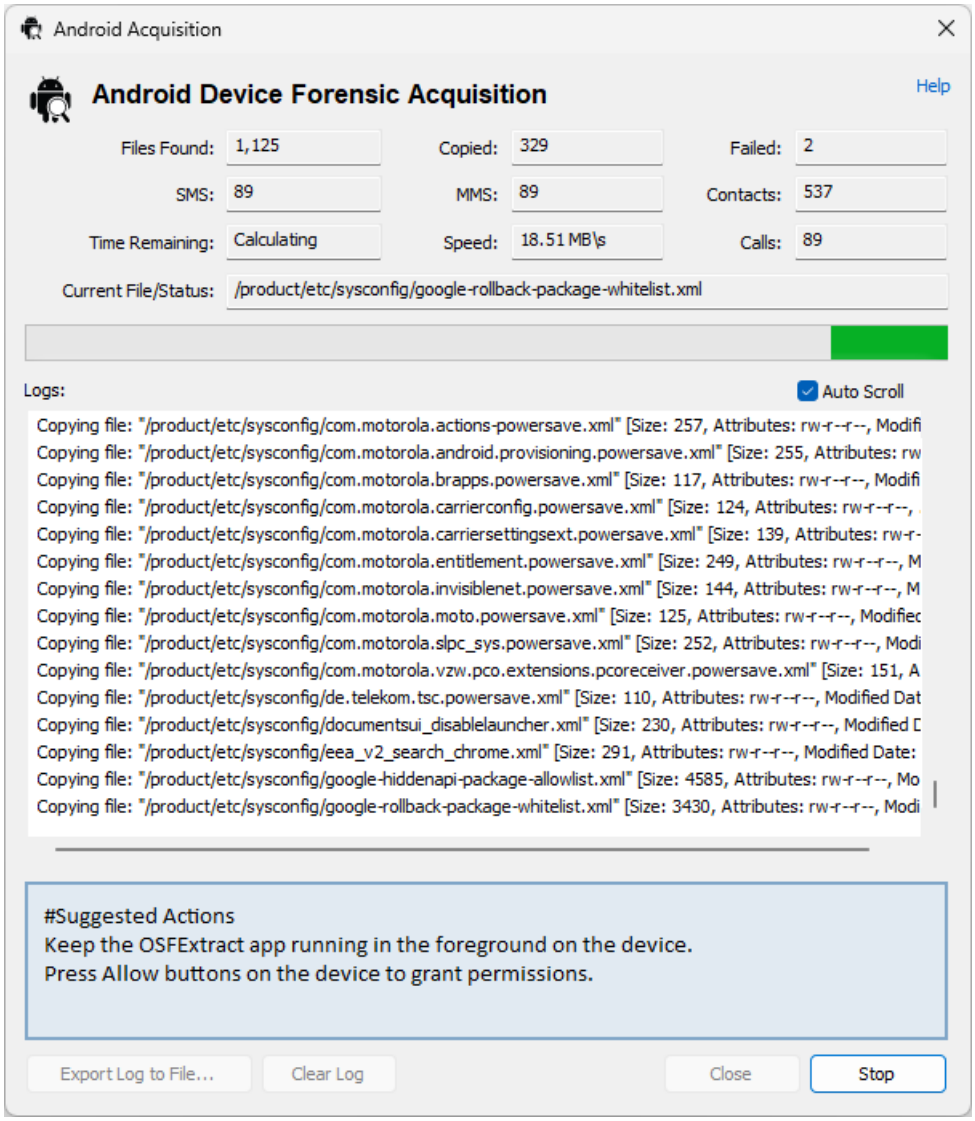


Once the data copy has completed, the wizard will create an OSForensics device encapsulating the location of the data (be it a VHD or a directory) and add that device to the case.

At this stage the user can use the "Next" button to proceed to the scanning stage where the newly acquired data data can be loaded into OSForensics for further analysis.

The user is presented with a list of devices in the current case to load into OSForensics and analyze.

This stage of the wizard is can be reached by:

- either proceeding through the wizard from the start, it being the stage that follows the completion of the ADB copy and OSFExtract data collection stage
- or with the "Load Existing" button

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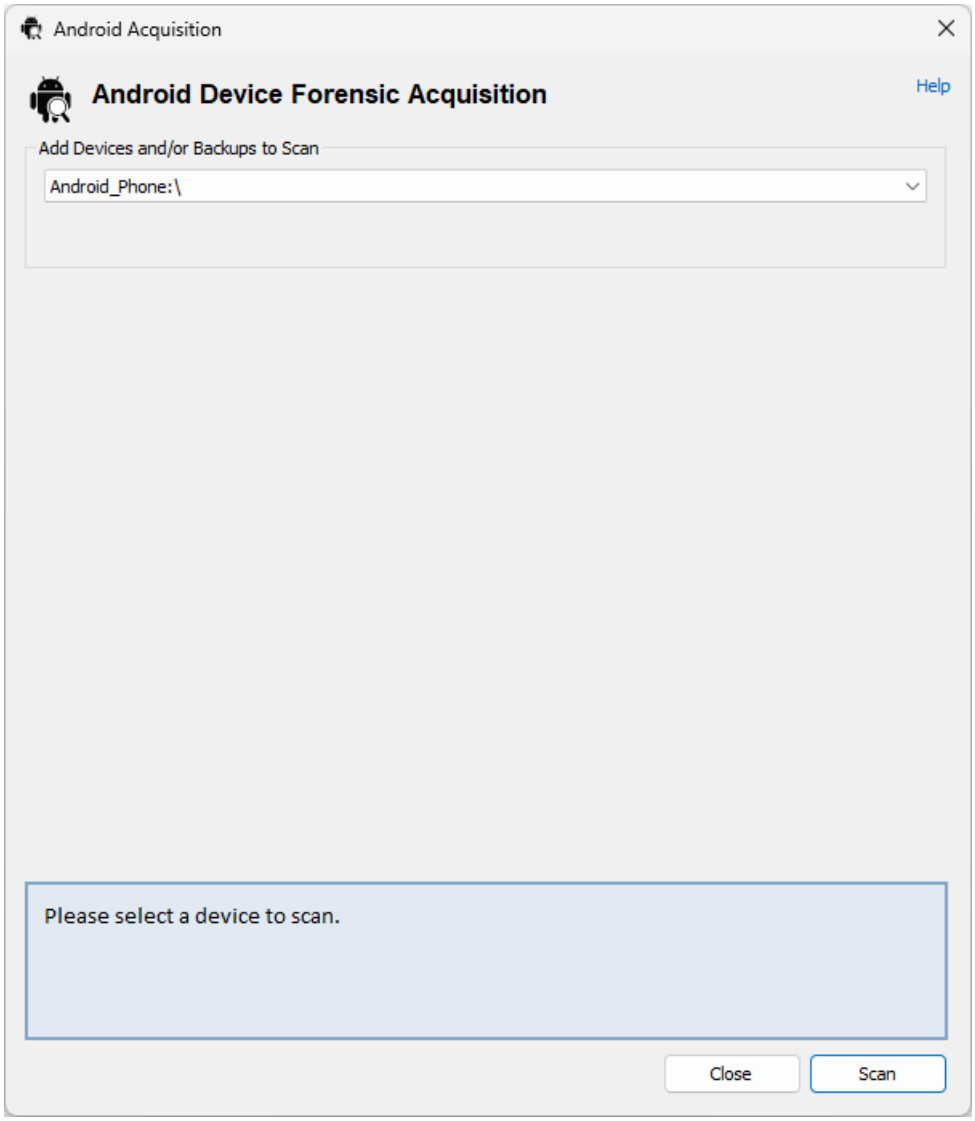


Selecting a device to scan and pressing the "Scan" button results in OSForensics searching through the device for Android artifacts

- Call Log
- MMS/SMS Message
- Contacts
- Conversations
- Photos

## Analyzing Android Forensic Data

Once the Android forensic data has been scanned and loaded into OSForensics the five types of forensic data become available for viewing and searching.

"Call Log" presents the OSFExtracted call logs of the Android phone.

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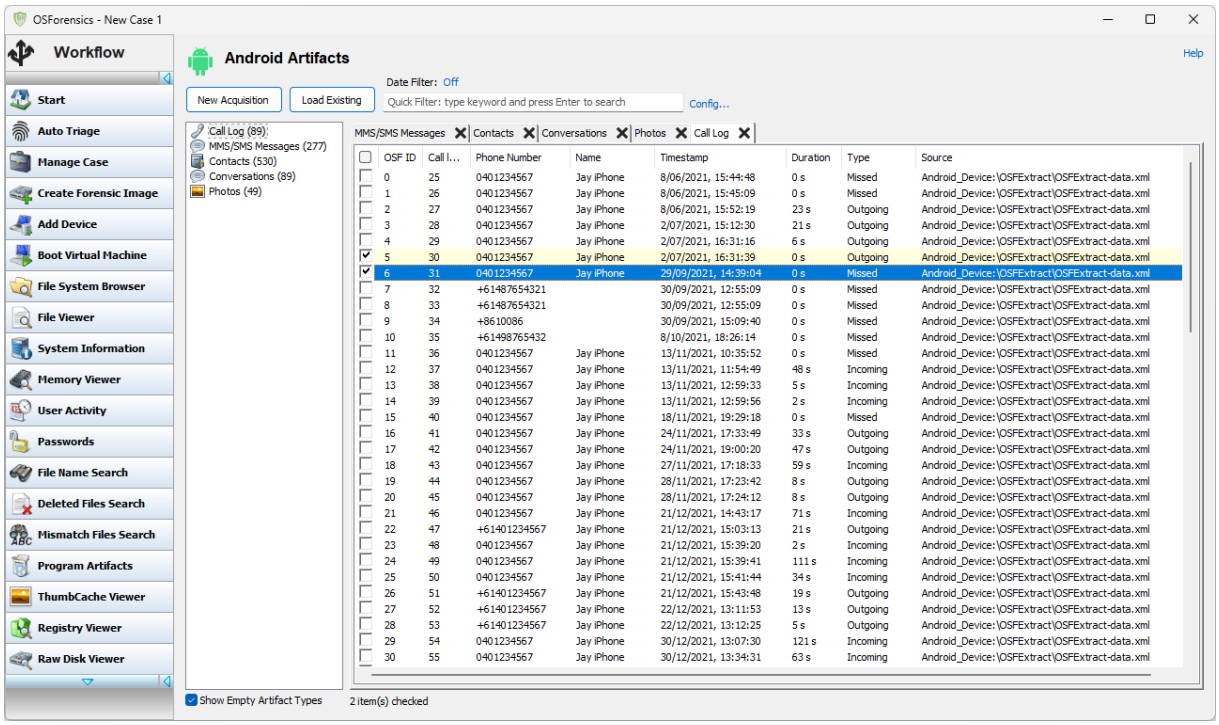


"MMS/SMS mesages" presents a view of all MMS and MMS messages extracted from the phone in chronological order (date sent for outbound messages, date received for inbound messages).

Selecting a message will bring up a view of the reconstructed conversation that that message is part of, presented as a text conversation on a phone.

The reconstructed conversation is presented from the point of view of the Android phone that it came from.

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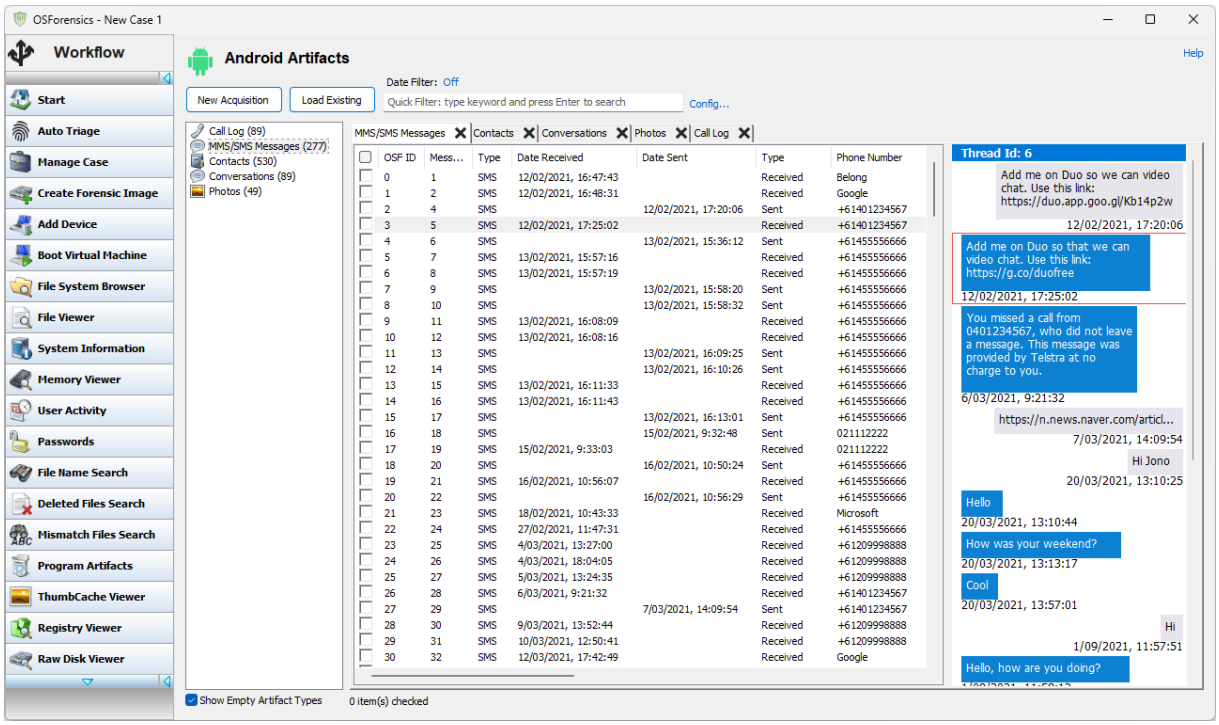
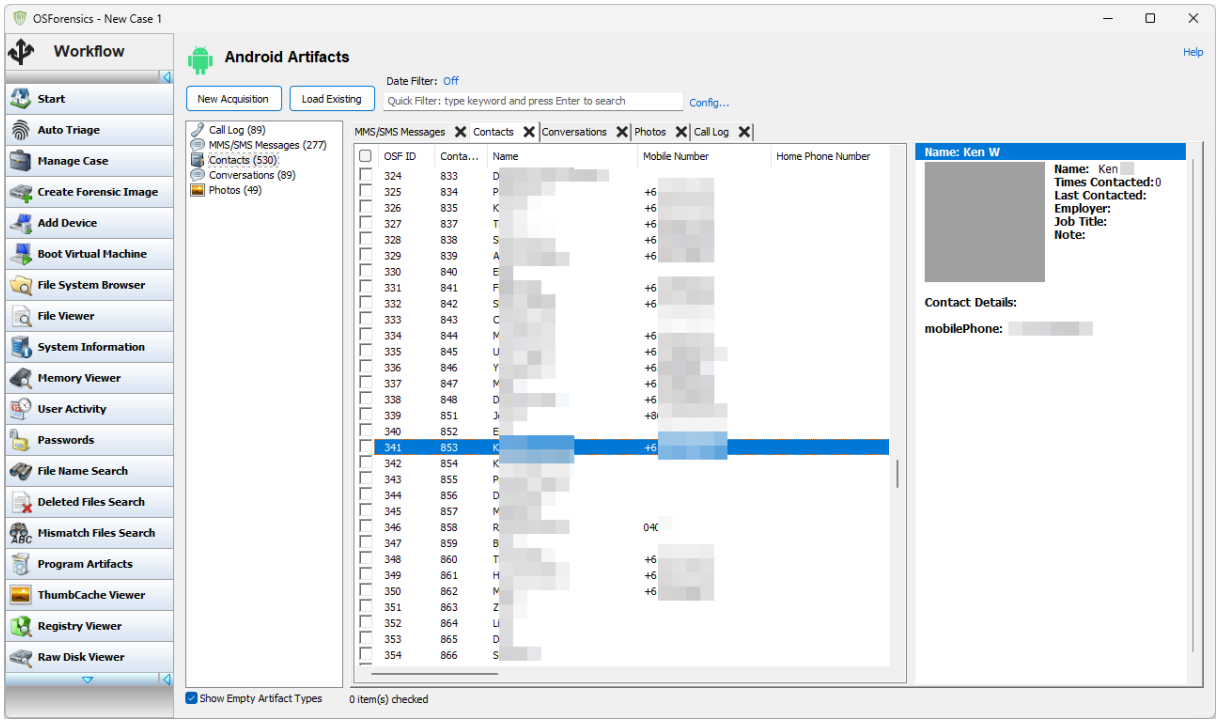



"Contacts" presents a view of all the extracted contacts from the phone.

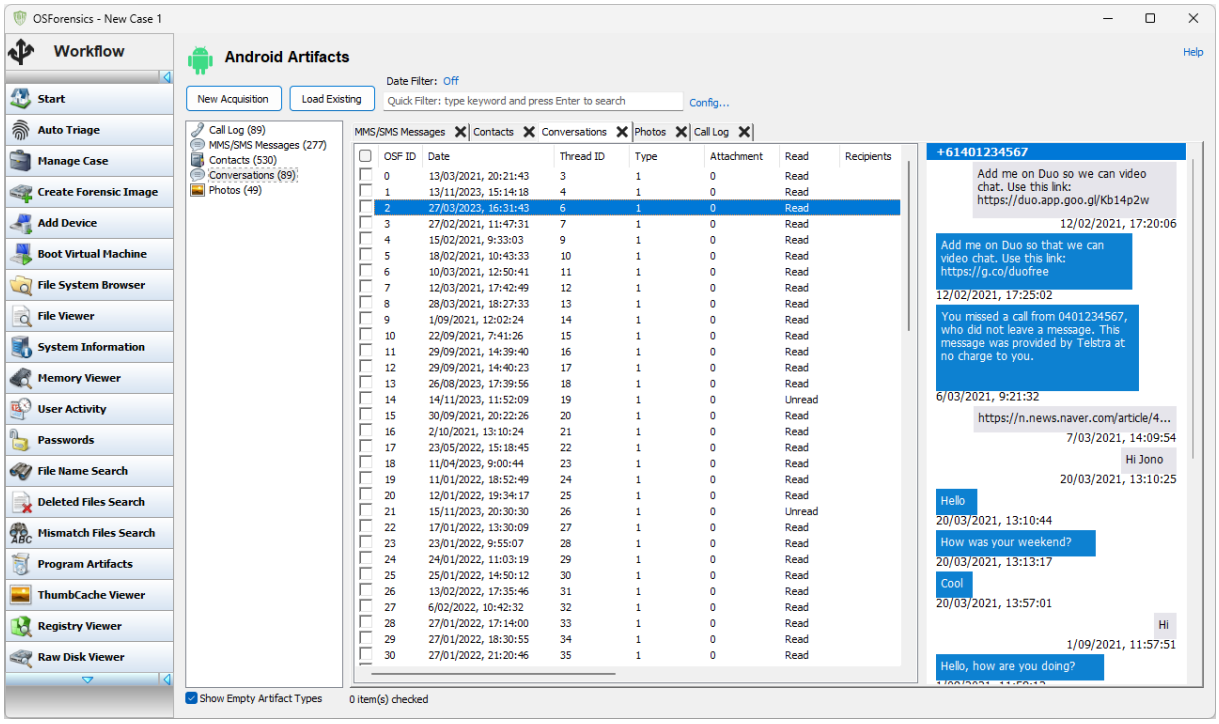
Contacts on Android can have a lot of subsidiary information. Clicking on an entry in the contact list brings up a details pane with additional details, if available.



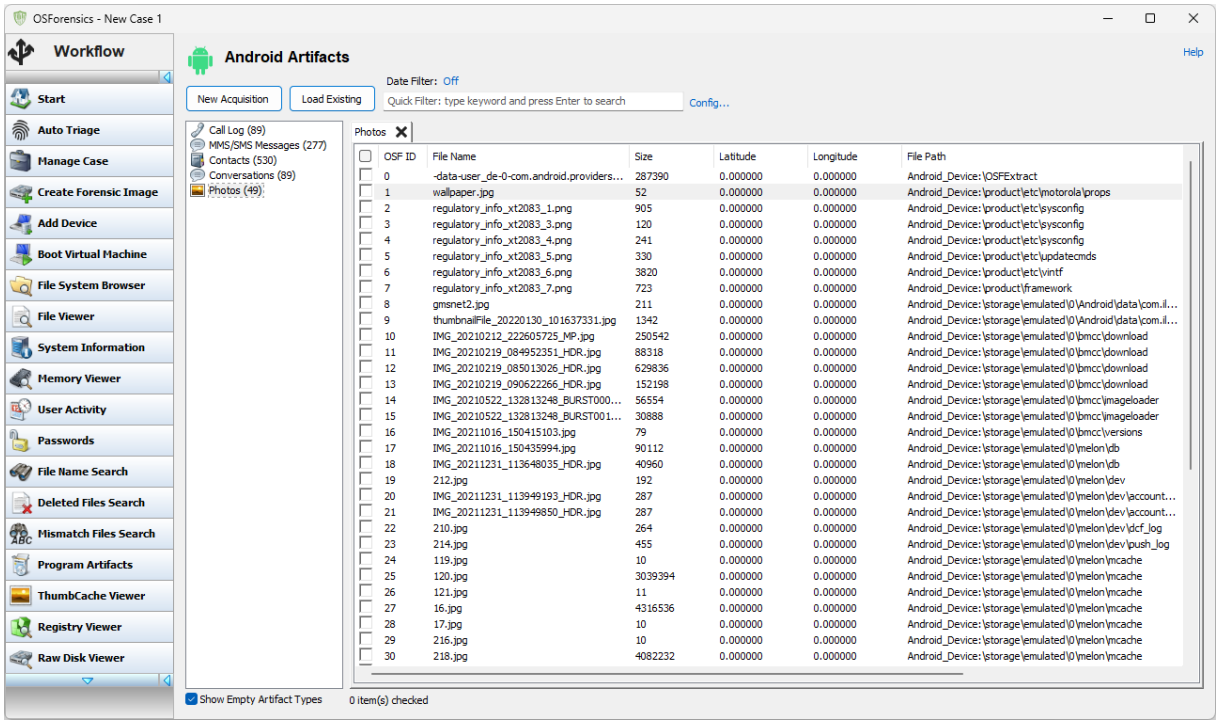

"Conversations" presents a view of all conversations extracted from the phone.

Selecting a conversation brings up a view of the reconstructed conversation.

Conversations are presented from the viewpoint of the Android phone being analyzed.




"Photos" presents a view of all photos extracted from the phone, be they part of an MMS message or just a photo that was taken on the Android phone and stored in one of the public directories.

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### 5.1.1 Android Artifacts Configuration

The Android Artifacts Configuration Window allows the user to configure the Android Artifacts scan options.

This window can be accessed by clicking on the "**Config...**" button on the **Start** tab of the Android Artifacts Module window.

**Call Log**
If checked, enables scanning for Call Logs in "data\com.android.providers.contacts\databases\contacts2.db".

**MMS**
If checked, enables scanning for MMS messages in "data\com.android.providers.telephony\databases\mmssms.db".

**SMS**
If checked, enables scanning for SMS messages in "data\com.android.providers.telephony\databases\mmssms.db".

**Contacts**
If checked, enables scanning for contacts in "data\com.android.providers.contacts\databases\contacts2.db".

**Photos**
If checked, enables scanning for photos entries in "data\\com.google.android.apps.photos\\db\ \gphotos0.db".

**Browser History**
If checked, enables scanning for browser URL history in "apps\\com.android.browser\\databases\ \browser2.db"

**Include dateless items**
If checked, will include items without an access date.

## 5.2 Auto Triage

Forensics triage is the process of obtaining the most relevant evidence data from a system within a a limited time frame. This is the case in particular for field personnel with limited forensics knowledge needing to collect forensics data in a time-critical situation. This practice is useful for non-forensic trained personnel, first responders, military personnel who are tasked with acquiring intelligence on-site, especially in potentially volatile situations (such as for Probation & Parole Officers on home visits). By collecting and prioritizing the most valuable evidence on-site, field personnel do not need to submit vast amounts of data for investigation and therefore can quickly focus on a specific area of interest (eg. internet and application history for probation officers).

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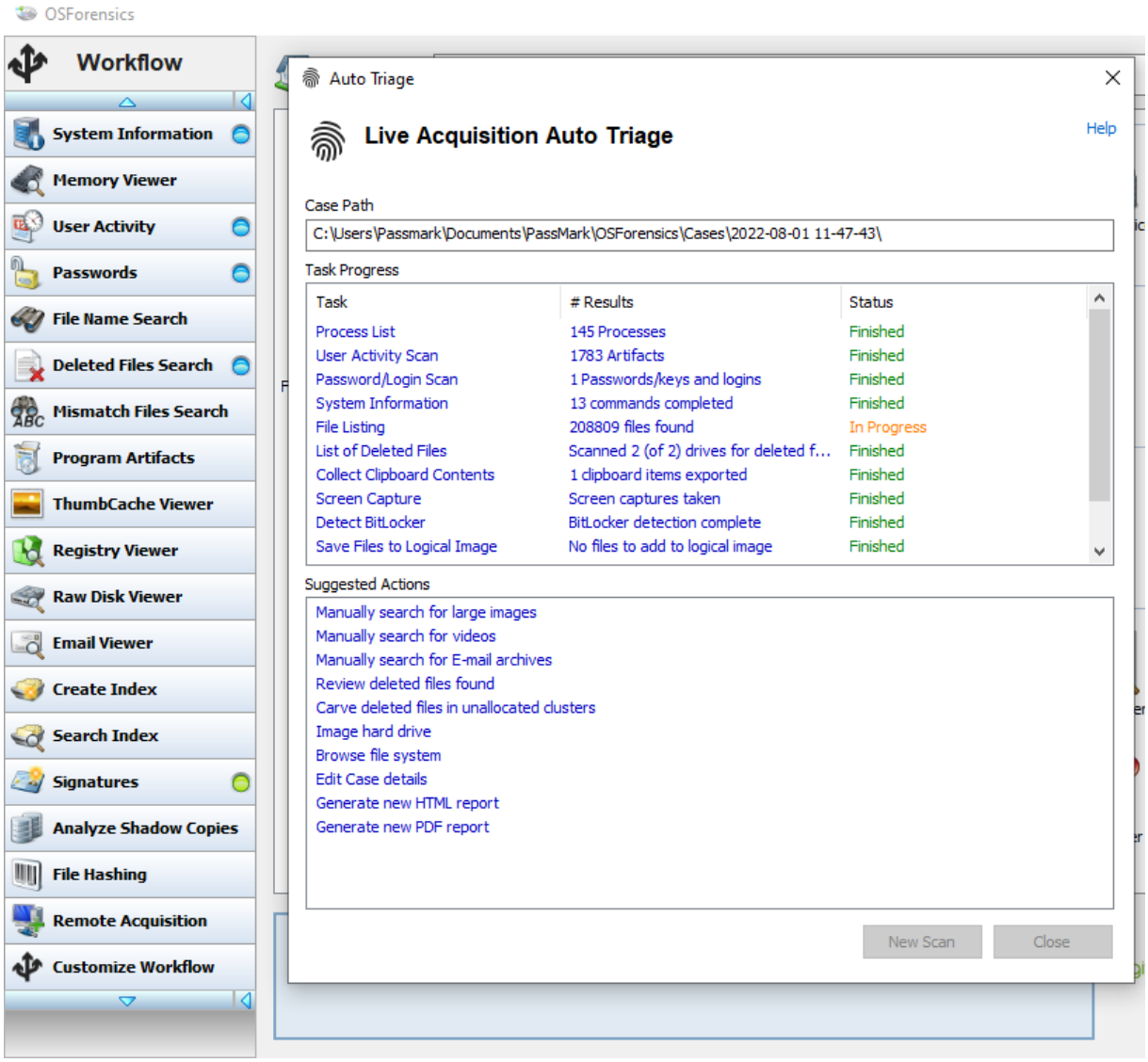


## Starting a Triage Scan

The forensics triaging process can be started by clicking on Auto Triage in the Workflow or Start window. Upon doing so, the following configuration dialog is shown which allows the investigator to customize the triaging process.

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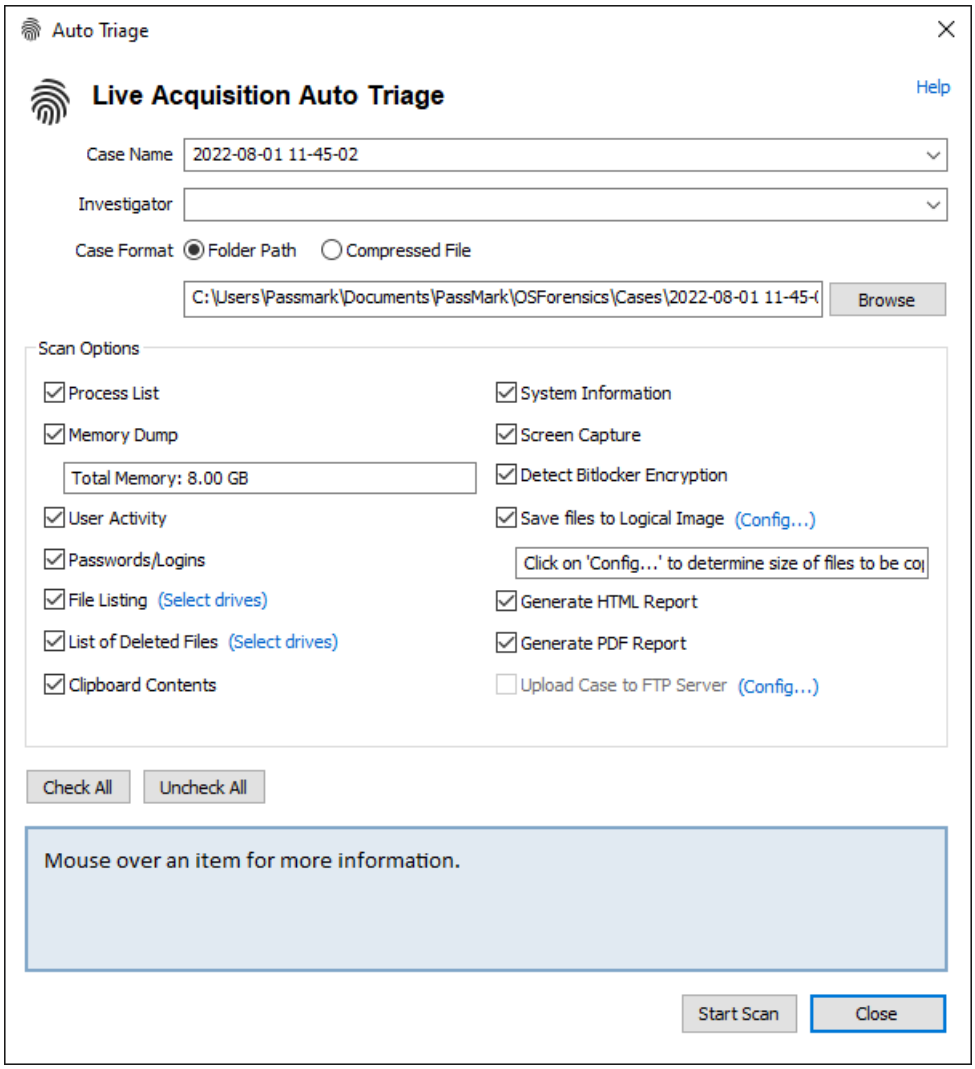


By default, the triage scan is pre-configured with the most common settings to allow the investigator to create a new case and initiate the evidence collection immediately. The investigator, however, can configure the files to be saved to a logical image by clicking on the (Config...) link.

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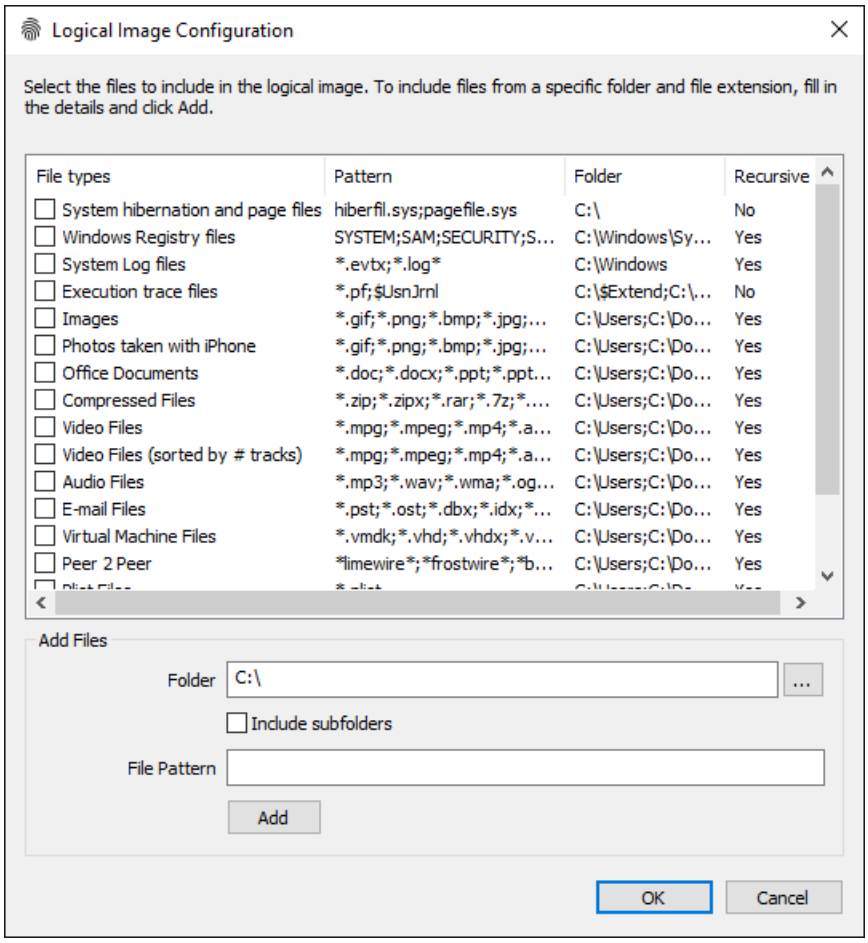


In this dialog, the files to be saved to a logical image can be selected from a default list or a user-specified start folder and file pattern to match. The default list of file types can be found (and modified) in the OSForensics Program Data folder, which is typically located in the following location:

`C:\ProgramData\PassMark\OSForensics\FileNameSearchPresets.cfg` (Vista and newer)

`C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\FileNameSearchPresets.cfg` (XP)

To start the triaging, click 'Start Scan'. Once the triaging process has started, the following progress dialog is shown which shows the state of all forensic tasks that are running.

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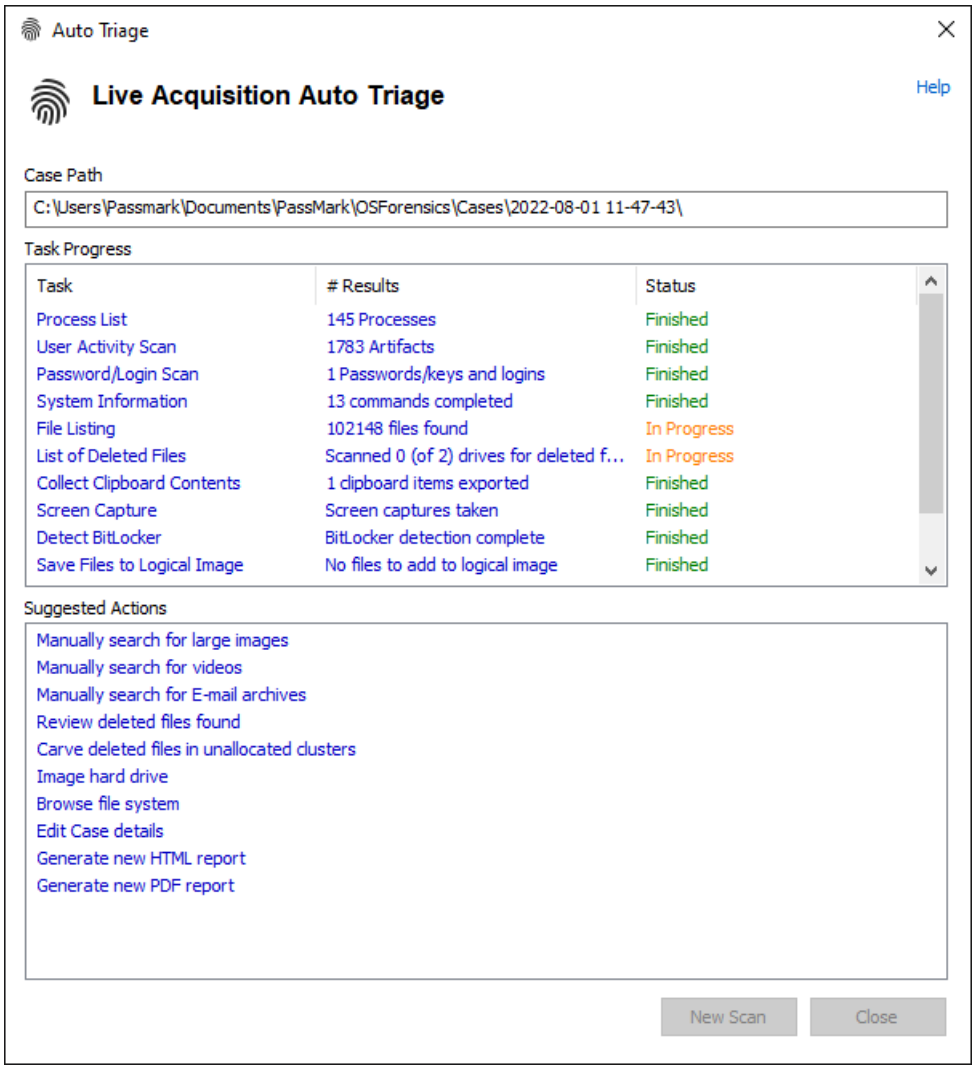


The progress of each configured task is displayed and updated in real-time. Once a task has completed, the results are automatically added to the case. The results can be accessed by clicking on the 'Finished' link upon completion.

In addition, a set of suggested actions is provided to supplement the data collected during the triaging process. By clicking on a specific action, the corresponding module is opened and configured appropriately for the investigator to initiate.

## 5.3 Boot Virtual Machine

Booting a disk image containing a functional operating system in a virtual environment provides the forensics investigator with a visual context of the system of interest, uncovering additional opportunities for evidence collection and analysis. In additional to being able to view the desktop environment of the system, files and executables that were inaccessible from static analysis can now be opened within the virtual environment.

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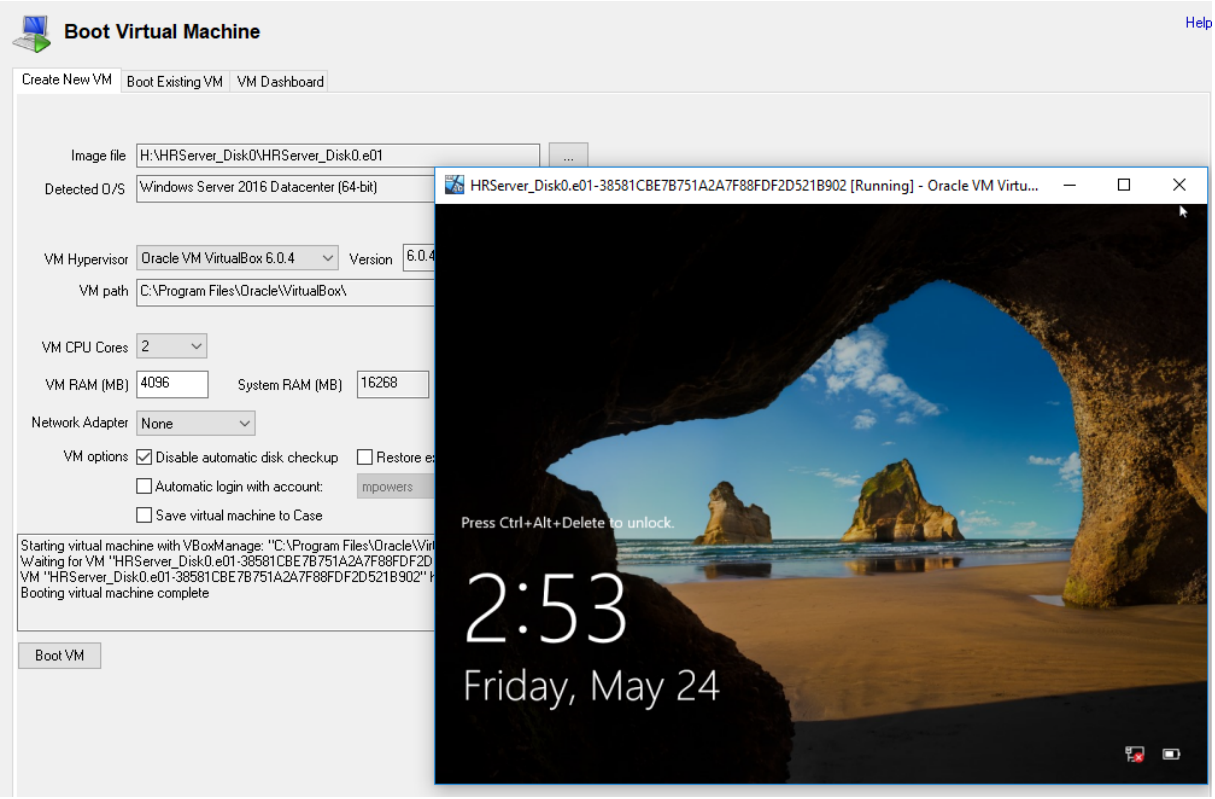


See Supported Guest Images / OS for the list of image formats and operating systems that have been successfully tested for virtual machine boot.

## Booting a new virtual machine

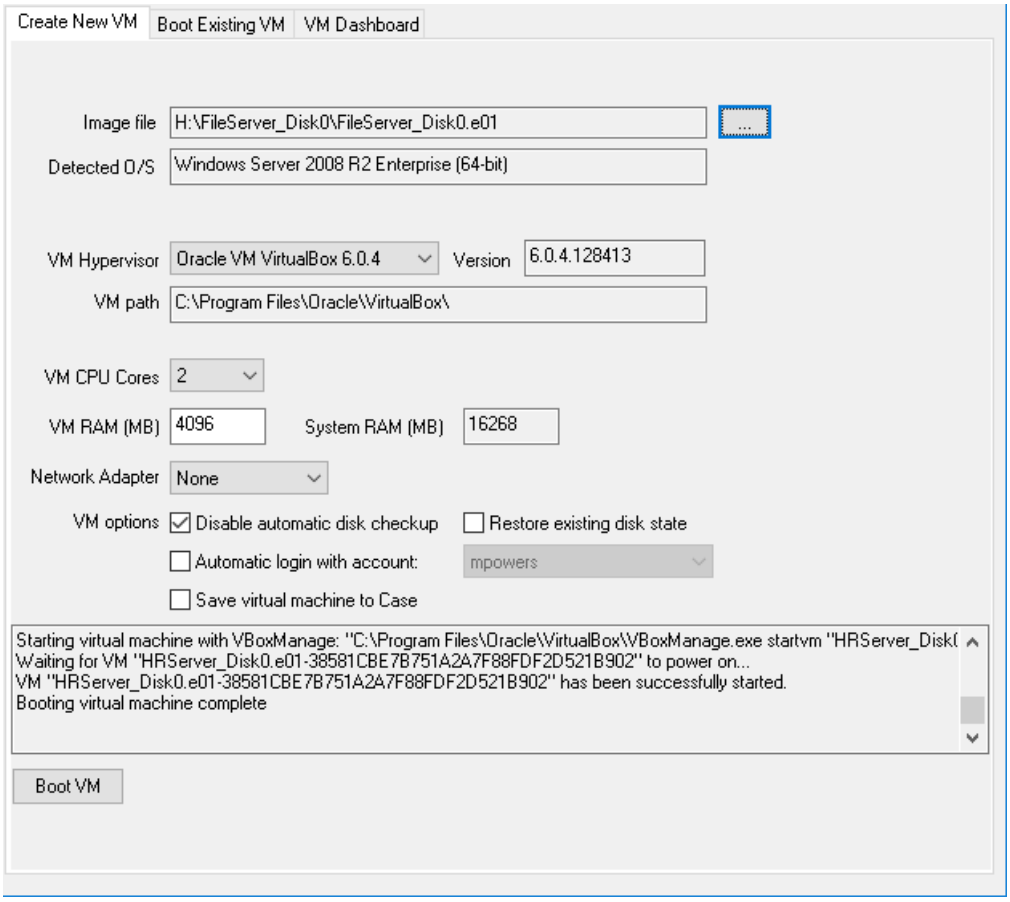


**Image file**
Select a disk image file to boot a new virtual machine instance. All disk writes within the virtual machine shall be stored in a separate delta write cache file, preserving the integrity of the disk image file.

**Detected O/S**
The operating system found on the disk

**VM Hypervisor**
Select one of the virtual machine hypervisors installed on the host machine

**VM path**
The virtual machine hypervisor install path

**VM CPU Cores**
Specify the number of CPU cores for the virtual machine

**VM RAM (MB)**
Specify the amount of system RAM for the virtual machine

**System RAM (MB)**
The amount of physical RAM available on the host system. the amount of VM RAM must not exceed this value.

**Disable automatic disk checkup**

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Check to disable automatic disk checkup on boot due to a dirty file system. This can occur if the disk image was acquired before the system was properly shutdown.

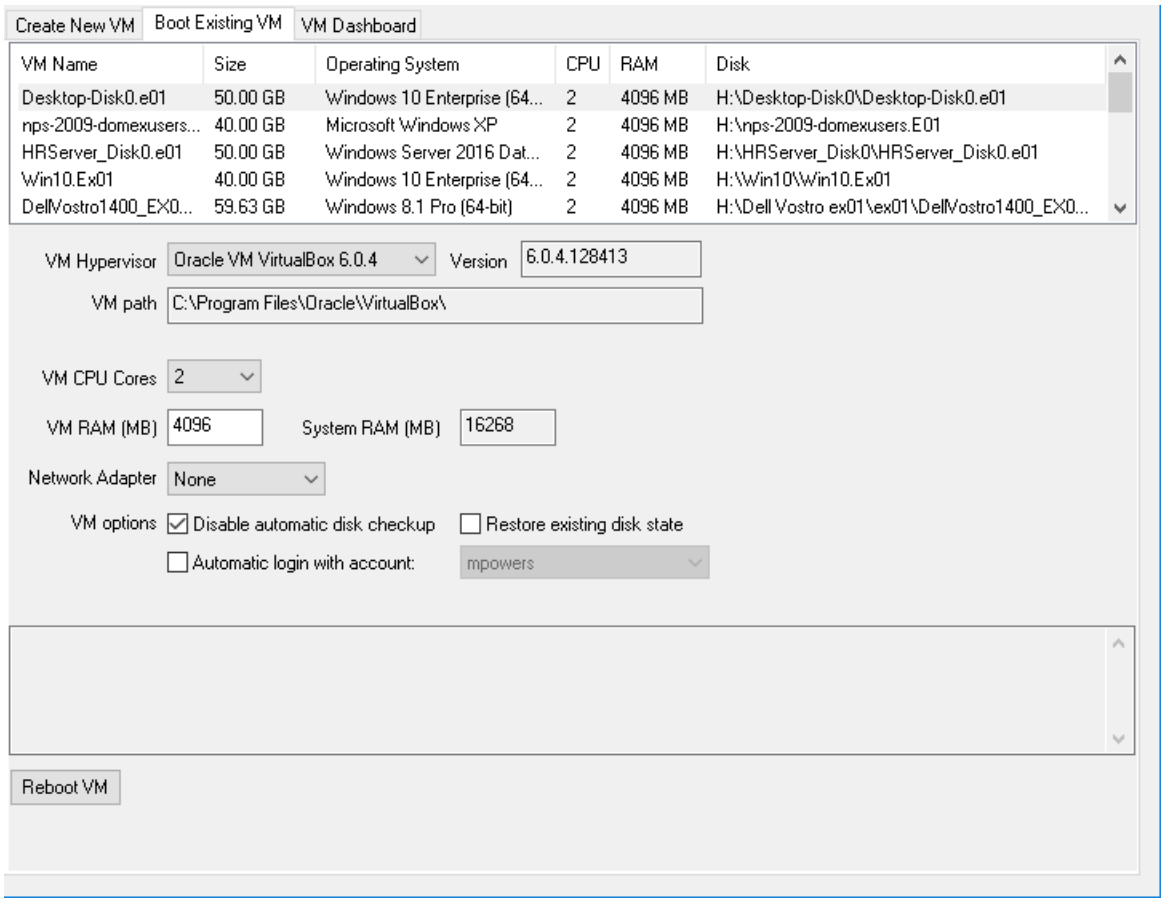
**Restore existing disk state**
Check to restore the disk state from a previous boot using the disk image's delta write cache file. Otherwise, the original disk image is used and a new delta write cache file is created.

**Automatic login with account**
Check to bypass the Windows account login screen and logon as the selected user.
*Note: This option attempts to bypass password verification, which may or may not be successful depending on the Windows version. This also does not work with Microsoft accounts and Windows 11.*

**Save virtual machine to Case**
Check to add the virtual machine to the case. This would be useful for booting or restoring the virtual machine at a later time.

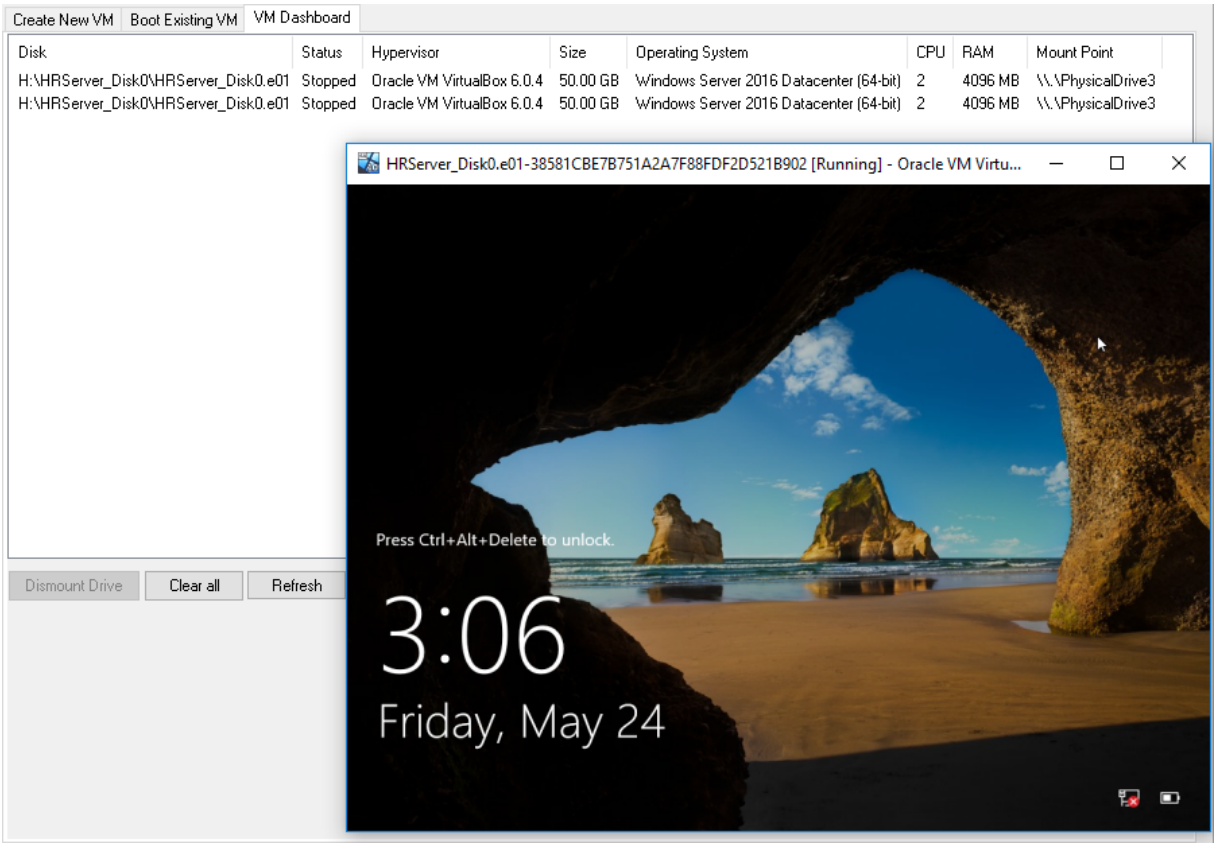
**Boot VM**
Start the virtual machine

## Booting an existing virtual machine



Virtual machines that have been added to the case can be rebooted or restored from its previous state. Select the desired virtual machine, modify any virtual machine settings and click on 'Reboot VM' to boot the virtual machine.

### Virtual Machine Dashboard




Once a virtual machine has been successfully booted, is shall be added to the dashboard. The status of all virtual machines that have been booted shall be displayed in the list.

**Dismount Drive**
Dismount the virtual physical drive from the host if the virtual machine is no longer running.

**Clear all**
Removes all virtual machines from the dashboard.

**Refresh**
Refresh the status of all virtual machines.

## 5.3.1 Supported Hypervisors / Guest Images

### Supported Hypervisors

- VMWare Workstation Player 14, 15, 16 and 17

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- VirtualBox 6, 7

The host operating system must be 64-bit while the guest virtual machine can be 32bit or 64bit.

## Supported Image Formats

- Raw Image (.IMG, .DD)
- Raw CD Image (.ISO, .BIN)
- Split Raw Image (.00n)
- Advanced Forensics Format* (.AFF, .AFD, .AFM)
- VMWare Image (.VMDK)
- EnCase Image (.E01, .Ex01)
- EnCase Logical Image (.L01, .Lx01)
- SMART Image (.S01)
- VHD Image (.VHD)

**The supported version of Advanced Forensics Format is AFFv3 with zlib compression support. Encryption and signatures are not supported.*

It is recommended to use uncompressed images or images mounted as RAM drives, since booting compressed images greatly reduces the performance of the guest virtual machine.

The following image formats are not supported:

- Advanced Forensics File Format 4 (.aff4)
- RAID images (images of RAID physical disks are not supported; they must first be rebuilt into a logical image)

In principle, only full disk images with a proper partition table (eg. MBR/GPT/APT) can be boot in a virtual machine; partition-only images cannot be boot except for ones that satisfy certain conditions. This includes images that use ntldr for booting (Windows XP) and bootmgr + BCD images (Vista and above), where a partition table can be simulated by pre-pending an MBR image to the disk in the .vmdk file.

## Verified Guest Operating Systems

Images with the following guest operating were successfully boot in a virtual machine. However, this does not mean that any image with the following operating systems shall boot successfully, nor does it mean that operating systems not in the list will not boot.

| | VirtualBox | VMWare Player |
|---|---|---|
| Windows XP (32-bit) | ✔ | ✔ |
| Windows Vista (32/64-bit) | ✔ | ✔ |
| Windows 7 (64-bit) | ✔ | ✔ |
| Windows 8.1 (64-bit) | ✔ | ✔ |

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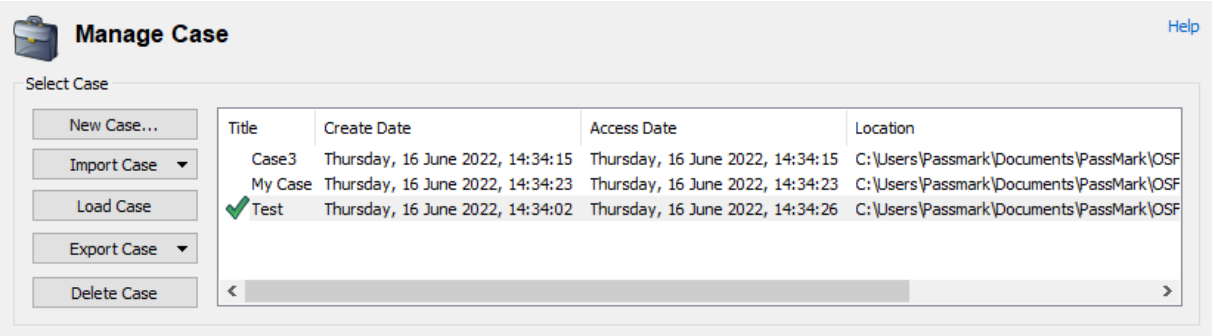
| | | |
|---|---|---|
| Windows 10 (64-bit) | ✔ | ✔ |
| Windows Server 2008 (64-bit) | ✔ | ✔ |
| Windows Server 2016 (64-bit) | ✔ | ✔ |
| CentOS 7 (64-bit) | ✔ | ✔ |
| MacOS 10.13 (High Sierra) | △* | ✘ |

** Boots to MacOS login screen but mouse/keyboard does not work*

## 5.4 Case Management

In the case management window can be used to create and manage cases. Cases are used to group together findings from other functions into a single location that can be exported or saved for later analysis.

A new case must be created, or a previous case loaded, before it is possible to add items to a case from the other functions.




**New Case**
Clicking the new case button will allow you to generate a new empty case in which to collect data into. A case must have a name, and may have an associated investigator although this is not required.

By default a case is created as in the OSForensics folder situated in the user's My Documents folder. On creation a sub folder will be created in the target location that will contain the case, there is no need to select an empty folder.

The timezone selection when creating a new case is used to change the display of times to match a preferred timezone, internally where possible all times are stored in UTC. Note that daylight saving time is not automatically accounted for.

**Import Case**
**Import Case Folder**
Add a case to the list that is not in the default case folder and load it.

Note that this does not copy the case folder, it just makes a reference to that folder selected. If the folder disappears (e.g. by removing the USB drive containing the case folder), then the case cannot be accessed.

In some cases it might make sense to manual copy the Case folder from the USB drive, to the internal drive before importing it.

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**Import Case File**
Add a case to the list that is not in the default case folder using a .zip file.

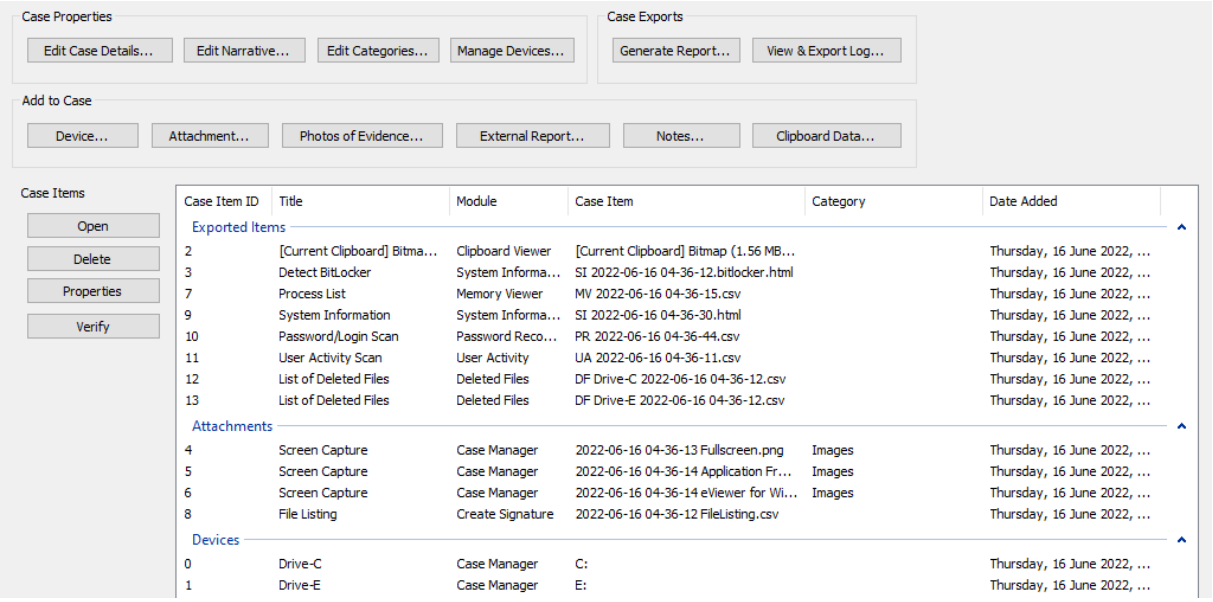
**Load Case**
Loads the currently selected case from the list. You can also simply double click in the list to perform the same action.

**Export Case**
Exports the currently selected case from the list to a specified directory.

**Delete Case**
Deletes the currently selected case. The user is given the option to backup the case data to a specified location before deleting.

## Case Manager

Once a case is created/opened, the contents of the case can be managed from this window. All Case items are displayed in the list, grouped by the Case item type.




A special group is the Tagged Items group. This group contains a list of items that need checking / verifying by an investigator before adding to the case.

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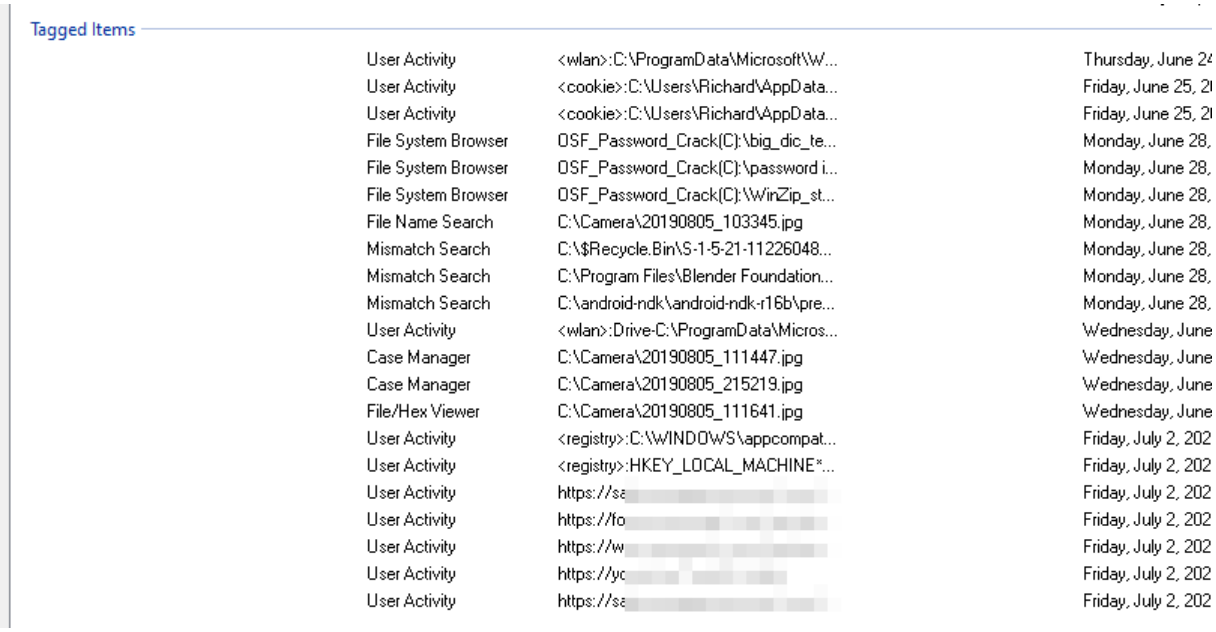
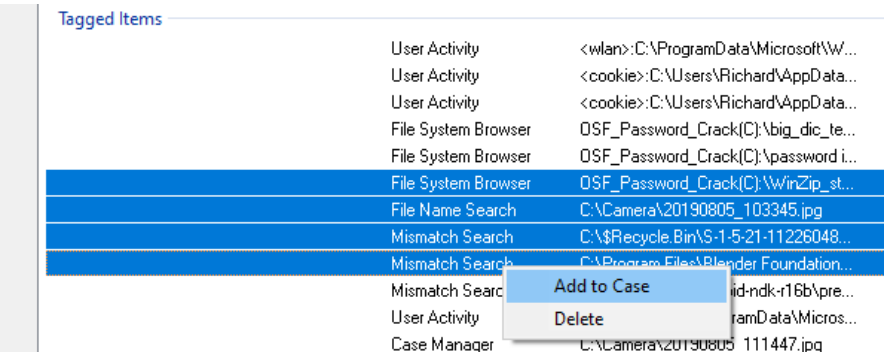
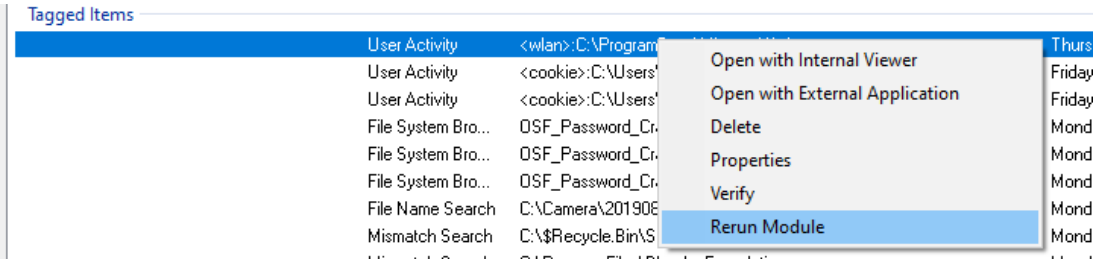



If the tagged items is referencing a file, the item can be added to case directly by right-clicking and selecting "Add to Case".




If however, the tagged item is a reference to an artifact (e.g. entry from within a database file), it would be necessary to Rerun the Module where the tagged item was added to continue investigation.




## Manage Current Case

### Case Properties

**Edit Case Details**
Edit the properties (eg. name, investigator, time zone, logging options) of the case.

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**Edit Narrative**
Edit the case narrative which includes additional case analysis details to be included in the generated report.

**Edit Categories**
Add or modify the list of categories that a case item can be assigned to.

**Manage Devices**
Manage all devices that have been added to the case.

### Case Exports

**Generate Report**
Creates a HTML report of the contents of the case. OSForensics has a number of built-in templates to choose from, which is fully customizable. You can also create your own custom template.

**View & Export Log**
If logging is enabled for the case, opens the log viewer for viewing and exporting the log entries.

### Add to Case

**Device**
Add a storage device to the case for analysis.

**Attachment**
Add a generic file to the case as an attachment.

**Photos of Evidence**
Add an evidence photo (eg. hard disk) to the case.

**External Report**
Add a report (eg. HTML, PDF) generated from an external tool to the case.

**Notes**
Edit the a note to the case as a text file.

**Clipboard Data**
Add existing bitmap or text content stored in the clipboard to the case.

## Case Items

**Open**
Opens the currently selected case item.

**Delete**
Deletes the currently selected case item.

**Properties**
Display or edit the properties for the currently selected case item. The case item can be modified by assigning to a category and/or editing the comments associated with the item.

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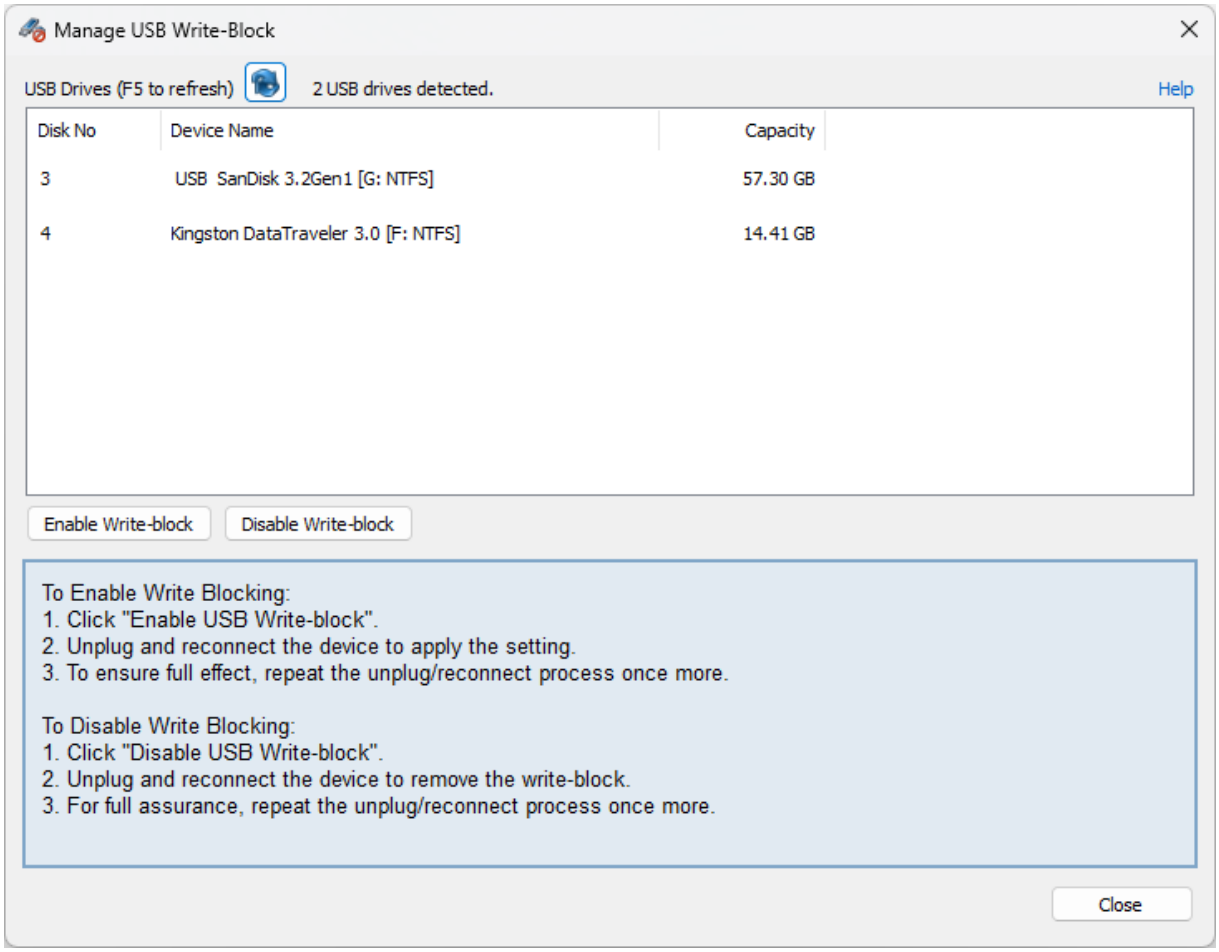
**Verify**
Calculates the SHA1, SHA256 and MD5 hashes for the file and compares them to the stored values.

### 5.4.1 USB Write-Blocking

The USB Write-Block feature in OSForensics prevents modifications to USB storage devices, ensuring forensic integrity. This feature helps investigators analyze USB drives without altering their contents.

⚠ **Important Note:**
OSForensics uses a **registry-based** method to enforce write-blocking. While effective in most cases, this method relies on Windows registry settings, which may not always be enforced immediately. Users may need to **unplug and replug** the device multiple times to ensure the setting is applied.

**For stronger write protection, we recommend using a hardware-based write-blocker**, which ensures true read-only access at the device level.




## Enabling & Disabling USB Write-Block

**How to Enable Write-Block:**

1. Open OSForensics and navigate to Manager "USB Write-Block".
2. Click "Enable Write-block".
3. Unplug and reconnect the USB device.
4. Unplug and reconnect it a second time to ensure enforcement.

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**How to Disable Write-Block:**

1. Click "Disable Write-block".
2. Unplug and reconnect the USB device.
3. Unplug and reconnect it a second time to fully remove write-blocking.

⚠ **Why is an extra unplug/replug needed?**
Since OSForensics modifies registry values to enforce write-blocking, Windows **does not always apply the changes immediately**. Disconnecting and reconnecting the USB device forces Windows to refresh its policies. In some cases, a **second replug is necessary** to ensure enforcement.

**When OSForensics exits, the registry settings will be restored to their original state, returning USB devices to normal operation.**
**However, to ensure the changes take full effect, you may need to unplug and reconnect the device twice.**

## How OSForensics Enforces Write-Blocking

OSForensics modifies the following Windows registry keys:

StorageDevicePolicies
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\StorageDevicePolicies\WriteProtect = 1

RemovableStorageDevices
HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\RemovableStorageDevices\Deny_Write = 1

However, **registry-based methods have limitations** due to:
✔ **Windows caching registry values instead of applying them immediately.**
✔ **Some USB controllers ignoring policy changes until a full system restart.**
✔ **Inconsistent behavior across different Windows versions.**

## Troubleshooting

**Write-block is not applied after enabling/disabling it**
✔ **Solution**: Unplug and replug the USB twice. If the issue persists, restart the PC.

**The device is still writable after enabling write-block**
✔ **Solution**:

- Restart OSForensics in Debug Mode.
- Verify that the device is listed in the Write-Block Manager.
- Click "Enable Write-block".
- Unplug and reconnect the USB device.
- Unplug and reconnect it a second time to ensure enforcement.
- Run the "Check Write-block" test to confirm.
- Open Registry Editor (regedit.exe) and manually check if the write-blocking keys were updated.

**Cannot safely eject USB after enabling/disabling Write-Block**
✔ **Solution**: Close any open files on the USB and eject it manually.

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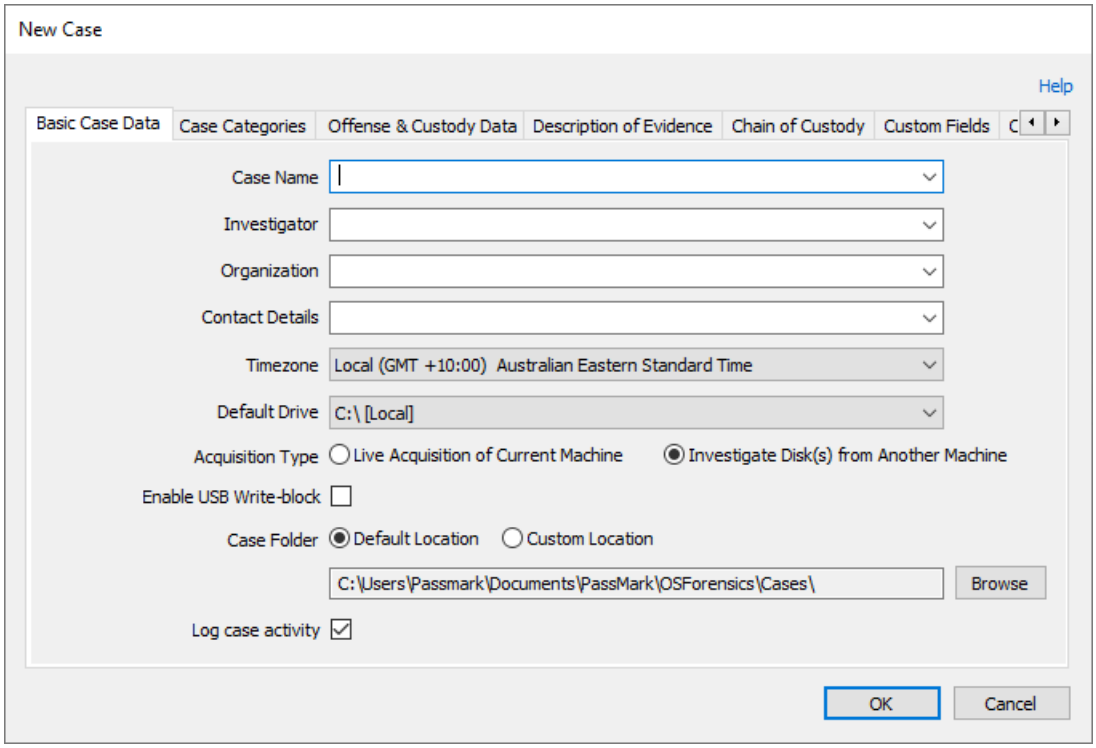
### 5.4.2 Editing Case Details

The Edit Case Details window allows the user to specify properties (e.g. name, investigator, time zone, logging options) of the case. Property editing is presented to the user when creating a New Case or when editing an existing case details.

## Basic Case Data




A case must have a name, and may have an associated investigator although this is not required. By default a case is created as in the OSForensics folder situated in the user's My Documents folder. On creation a sub folder will be created in the target location that will contain the case, there is no need to select an empty folder. The timezone selection when creating a new case is used to change the display of times to match a preferred timezone, internally where possible all times are stored in UTC. Note that daylight saving time is not automatically accounted for.

**Display Date Format**
Change the date format to display in for the selected case. Remember to configure this option before you export any case items.

## Case Categories

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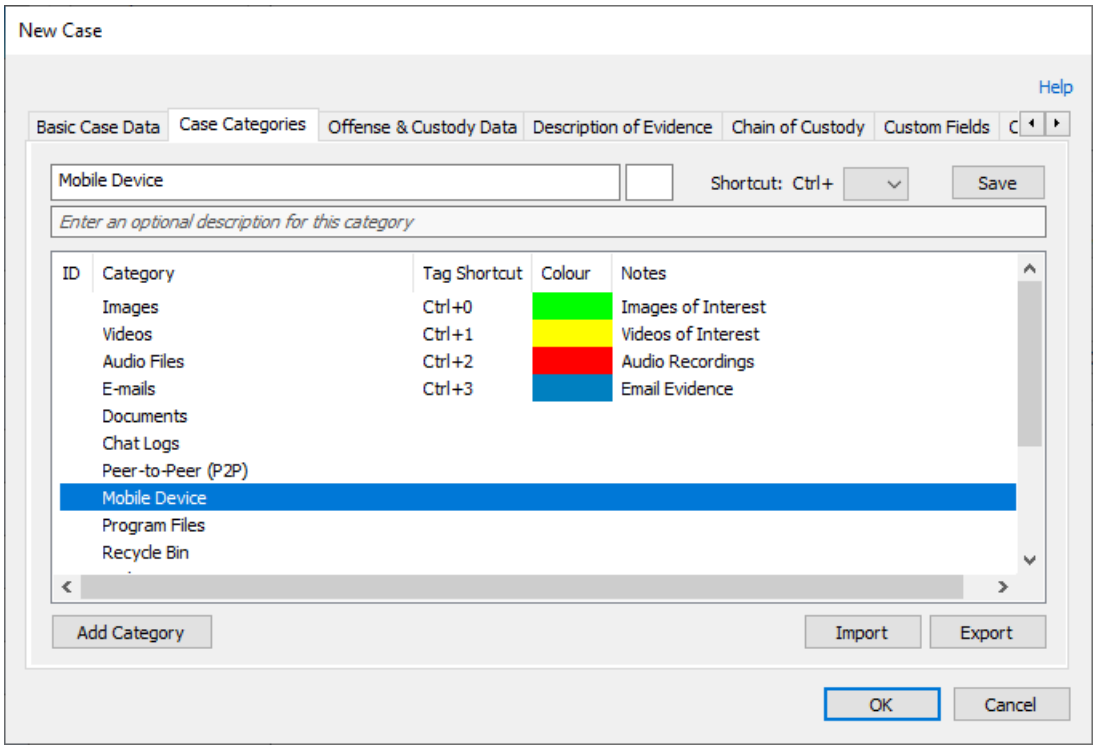


This tab contains the list of categories defined in the case. The default list of categories can be found (and modified) in the OSForensics Program Data folder, which is typically located in the following location:

```
C:\ProgramData\PassMark\OSForensics\Categories.txt (Vista and newer)

C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\Categories.txt (XP)
```

Clicking on the category allows modifying of its attributes. Once the changes to the category have been made, click 'Save' to apply the changes.

To add a new category, click 'Add Category'.

A category consists of a unique name, optional notes, highlight colour and a shortcut key for tagging. New or existing case Items can be assigned to a category.

If a highlight colour is assigned to the category, any item belonging to the category shall be marked with the specified colour as shown in the following screenshot.

Modified category options can be saved by clicking the 'Export' button and selecting a location.

An exported category template can then be loading by selecting the saved file with the 'Import' button.

By default category templates are saved to:

```
C:\ProgramData\PassMark\OSForensics\CategoryTemplates\
```

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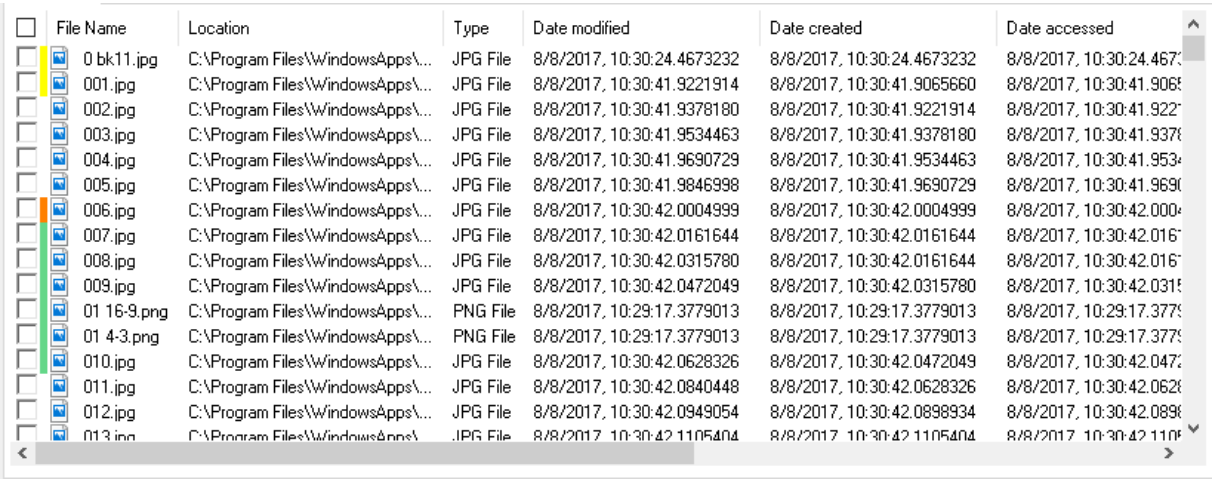
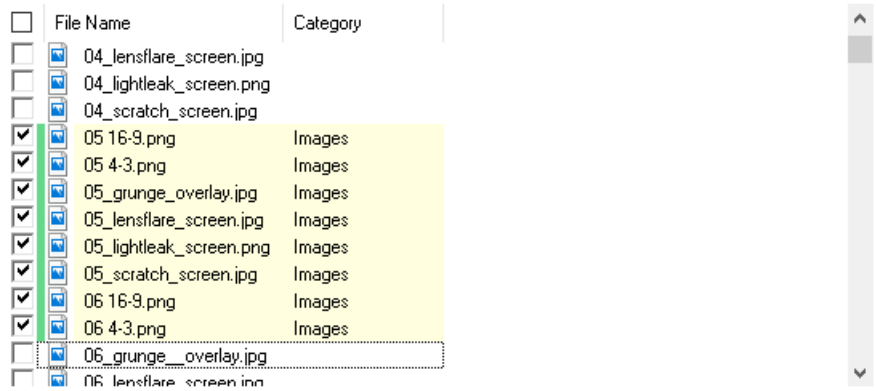


| File Name | Location | Type | Date modified | Date created | Date accessed |
|---|---|---|---|---|---|
| 0 bk11.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:24.4673232 | 8/8/2017, 10:30:24.4673232 | 8/8/2017, 10:30:24.467 |
| 001.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:41.9221914 | 8/8/2017, 10:30:41.9065660 | 8/8/2017, 10:30:41.906 |
| 002.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:41.9378180 | 8/8/2017, 10:30:41.9221914 | 8/8/2017, 10:30:41.922 |
| 003.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:41.9534463 | 8/8/2017, 10:30:41.9378180 | 8/8/2017, 10:30:41.937 |
| 004.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:41.9690729 | 8/8/2017, 10:30:41.9534463 | 8/8/2017, 10:30:41.953 |
| 005.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:41.9846998 | 8/8/2017, 10:30:41.9690729 | 8/8/2017, 10:30:41.969 |
| 006.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0004999 | 8/8/2017, 10:30:42.0004999 | 8/8/2017, 10:30:42.000 |
| 007.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0161644 | 8/8/2017, 10:30:42.0161644 | 8/8/2017, 10:30:42.016 |
| 008.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0315780 | 8/8/2017, 10:30:42.0161644 | 8/8/2017, 10:30:42.016 |
| 009.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0472049 | 8/8/2017, 10:30:42.0315780 | 8/8/2017, 10:30:42.031 |
| 01 16-9.png | C:\Program Files\WindowsApps\... | PNG File | 8/8/2017, 10:29:17.3779013 | 8/8/2017, 10:29:17.3779013 | 8/8/2017, 10:29:17.377 |
| 01 4-3.png | C:\Program Files\WindowsApps\... | PNG File | 8/8/2017, 10:29:17.3779013 | 8/8/2017, 10:29:17.3779013 | 8/8/2017, 10:29:17.377 |
| 010.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0628326 | 8/8/2017, 10:30:42.0472049 | 8/8/2017, 10:30:42.047 |
| 011.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0840448 | 8/8/2017, 10:30:42.0628326 | 8/8/2017, 10:30:42.062 |
| 012.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.0949054 | 8/8/2017, 10:30:42.0898934 | 8/8/2017, 10:30:42.089 |
| 013.jpg | C:\Program Files\WindowsApps\... | JPG File | 8/8/2017, 10:30:42.1105404 | 8/8/2017, 10:30:42.1105404 | 8/8/2017, 10:30:42.110 |

If a shortcut key is specified, items can be tagged and assigned to the associated category by pressing the shortcut key sequence as shown in the following screenshot.



| File Name | Category |
|---|---|
| 04_lensflare_screen.jpg | |
| 04_lightleak_screen.png | |
| 04_scratch_screen.jpg | |
| 05 16-9.png | Images |
| 05 4-3.png | Images |
| 05_grunge_overlay.jpg | Images |
| 05_lensflare_screen.jpg | Images |
| 05_lightleak_screen.png | Images |
| 05_scratch_screen.jpg | Images |
| 06 16-9.png | Images |
| 06 4-3.png | Images |
| 06_grunge_overlay.jpg | |
| 06_lensflare_screen.jpg | |

## Offense & Custody Data

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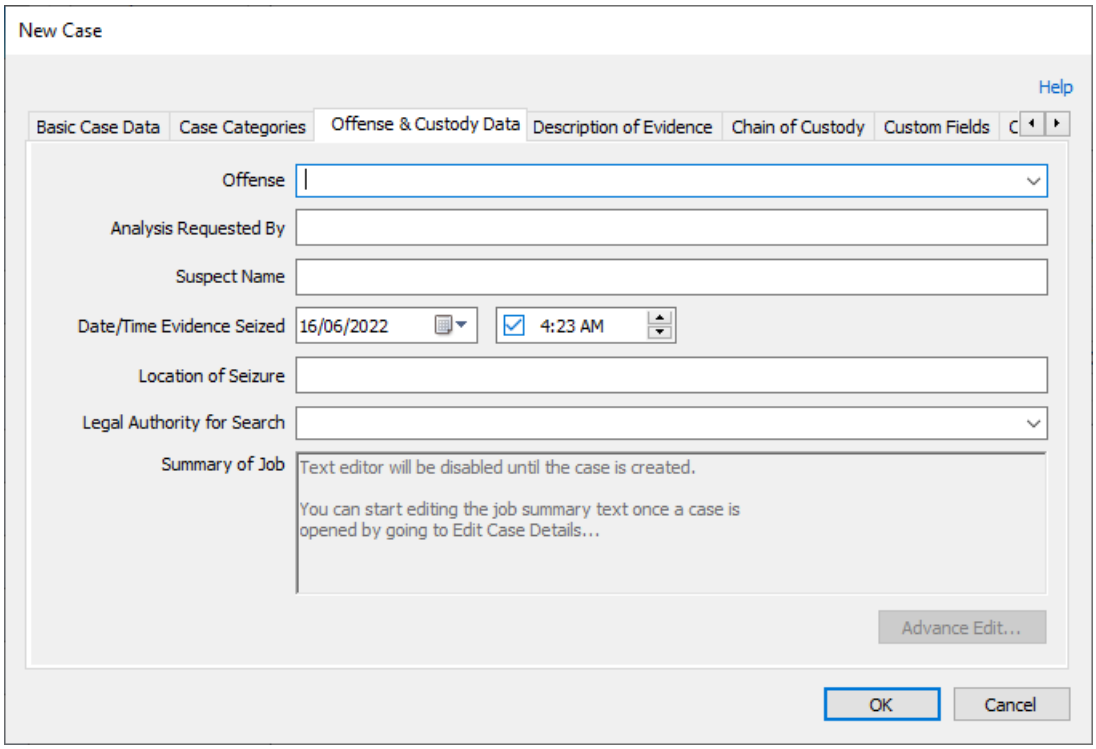
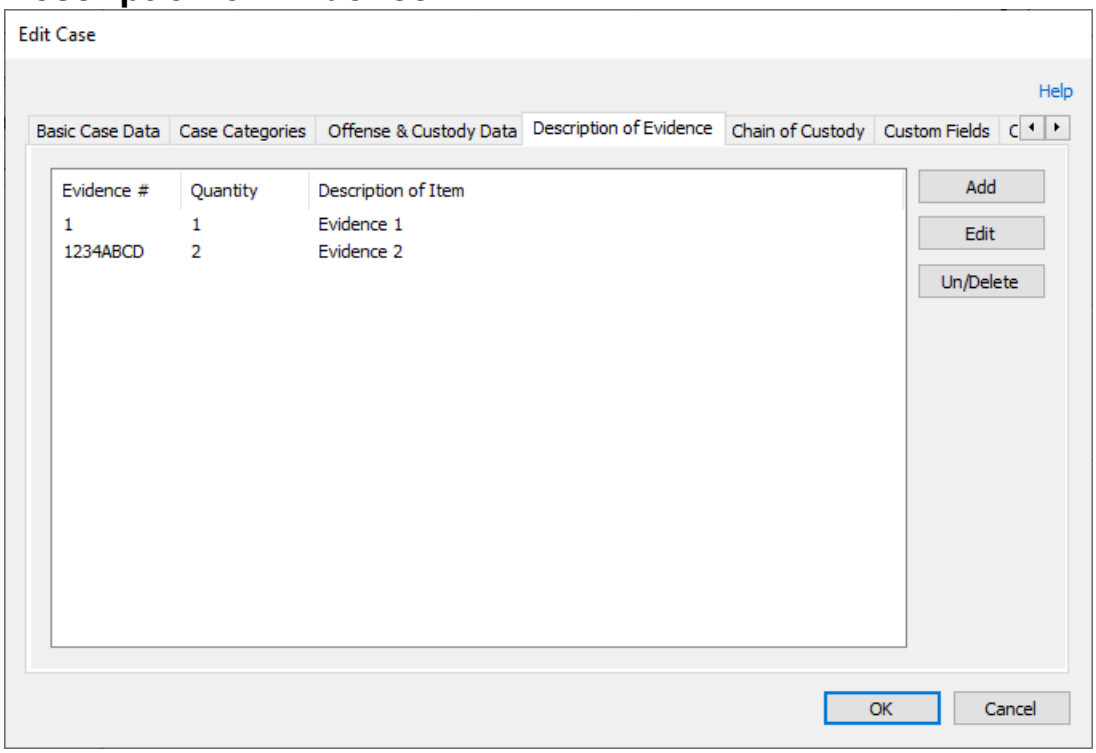



This tab contains the case custody data that is used when generating the default Chain of Custody Report. All fields are optional.

## Description of Evidence

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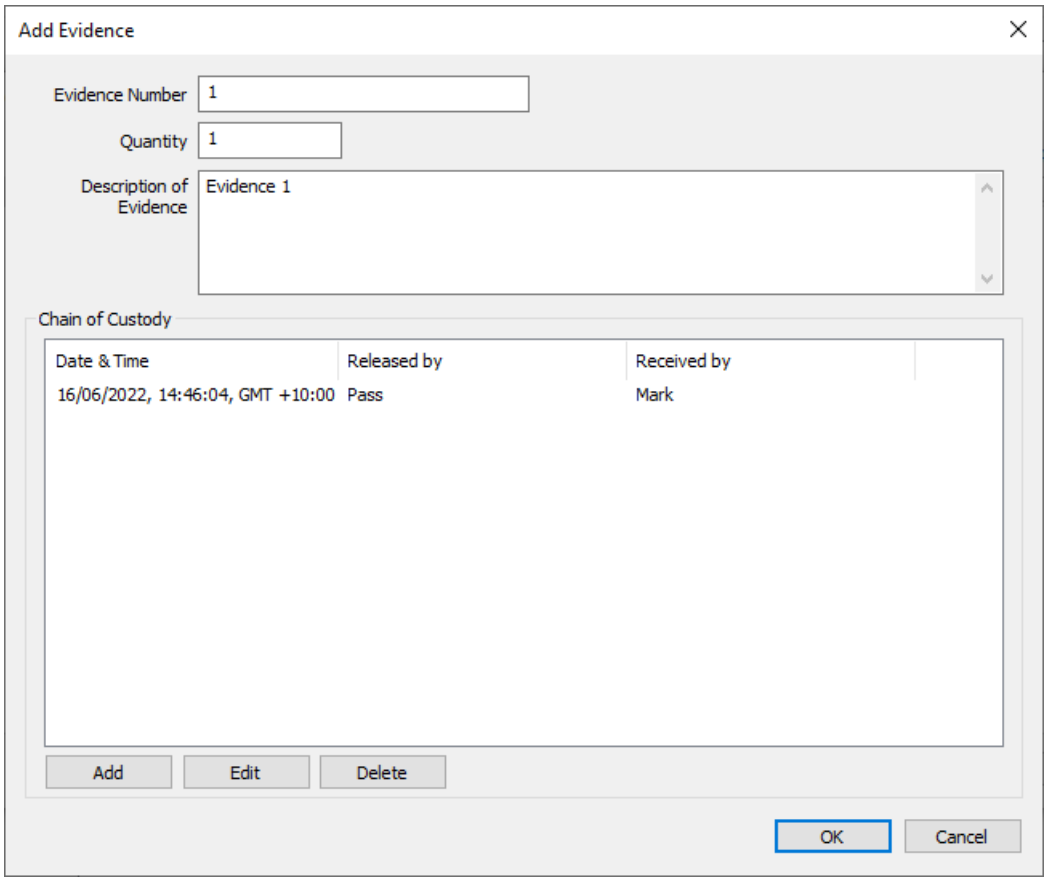
**Add/Edit**
Add a new evidence item collected to the case.




**Edit**
Edit an existing evidence item previously added in the case.

**Un/Delete**
Delete a previously added evidence item in the case. To prevent accidental deletions, the actual deletion is done when choosing "OK" to save the case.

## Chain of Custody

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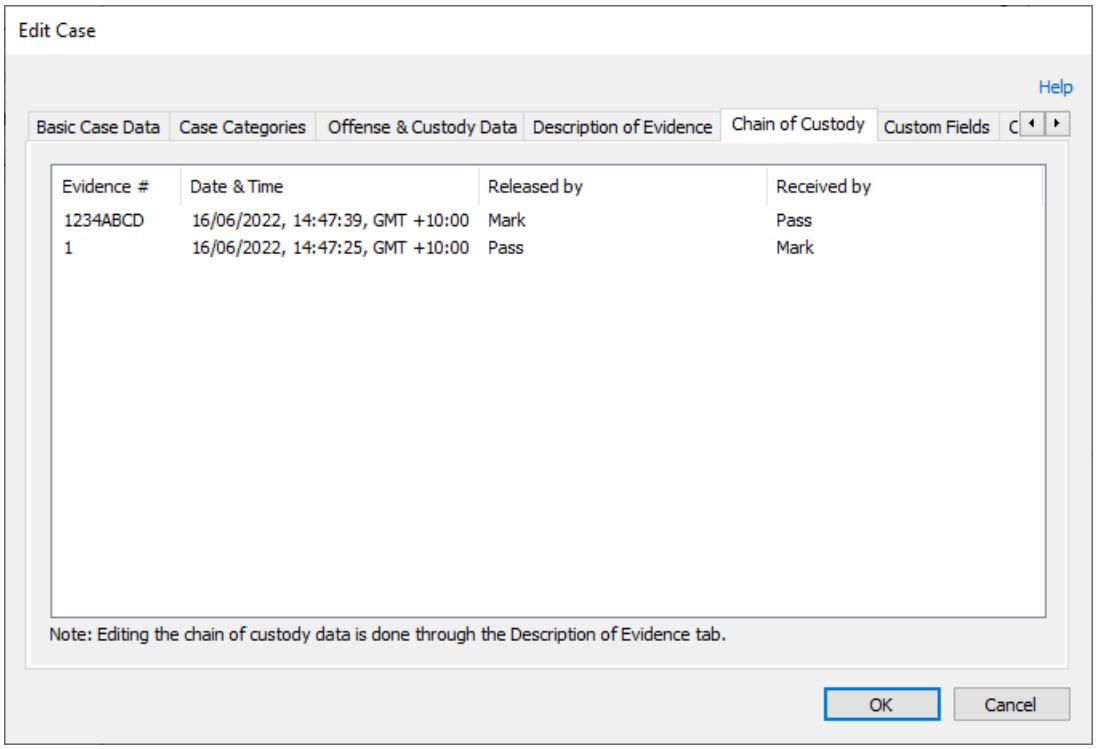
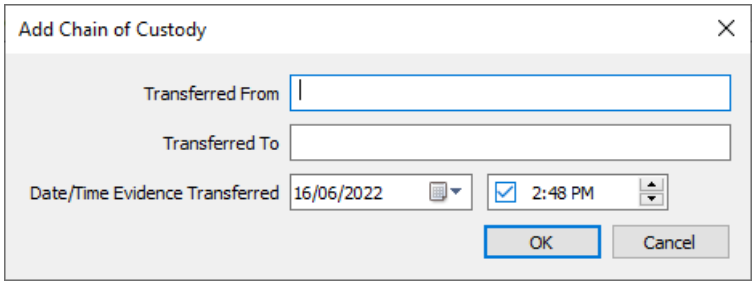
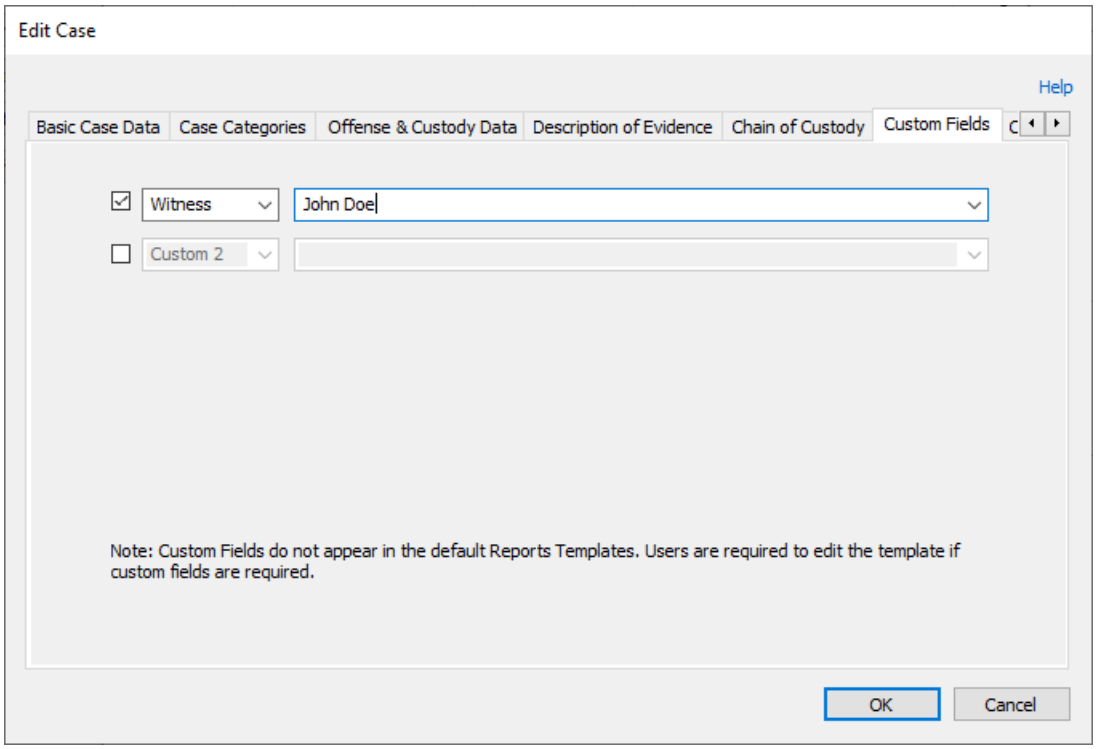



Shows the Chain of Custody for the added evidence items added to the case. Editing of the Chain of Custody can be accomplished in the Description of Evidence Tab. Select the Evidence and choose Edit.




When the Evidence Window opens, options are to Add a new chain entry, Edit an existing chain entry or Delete an existing chain entry.

## Custom Fields




User specified Custom Fields to include in the report for other properties the investigator may want to specify but does not currently exist. Custom Fields do not appear in the default Reports Templates. If custom fields are required, users can edit the templates. Specifically adding <!--OSF_CASE_CUSTOMFIELD1_NAME--> and <!--OSF_CASE_CUSTOMFIELD1_VALUE--> or <!--OSF_CASE_CUSTOMFIELD2_NAME--> and <!--OSF_CASE_CUSTOMFIELD2_VALUE-->to the templates where the fields need to appear.

## Case Narrative

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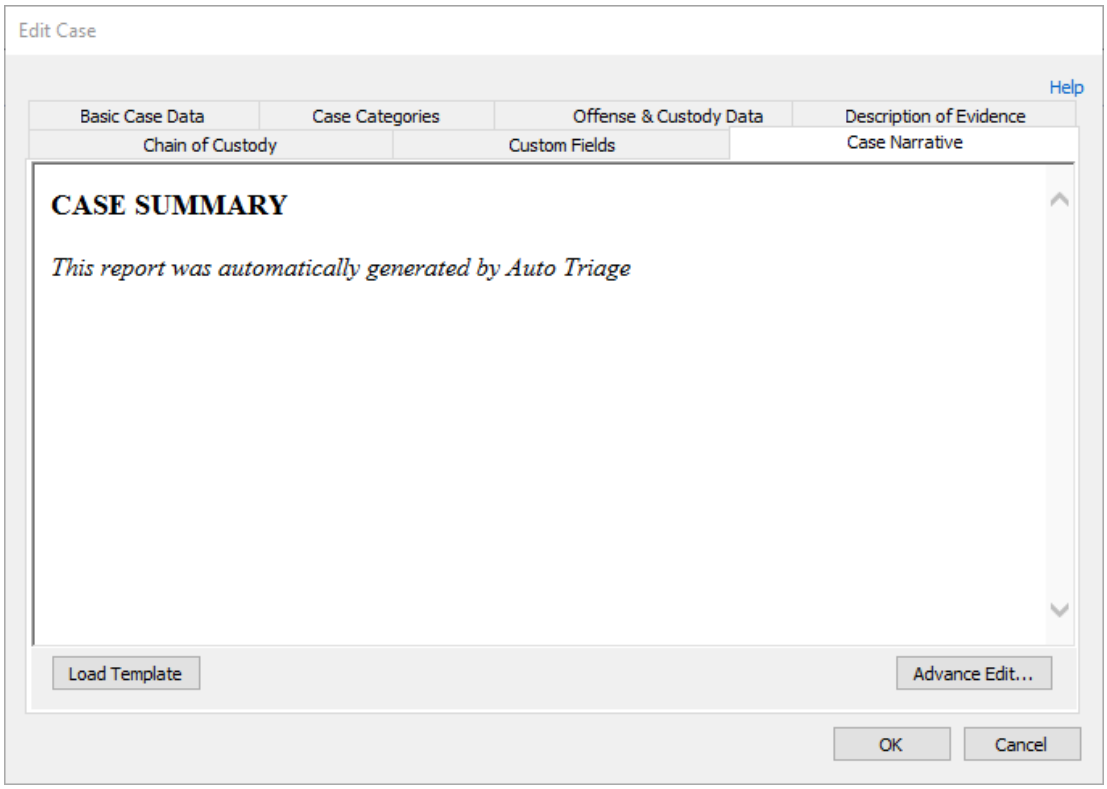


The Case Narrative allows the examiner to view their complete case analysis report. Text displayed here is included in the generated report. Case Narrative is editable after the case is created using the advanced editor.

**Load Template**
Load an existing saved template to be reused for this case.

**Advance Edit...**
Opens an advance HTML/Text Editor to write the case narrative.

### 5.4.3 HTML/Text Editor

The HTML/Text Editor allows for customization of the entered text. Text can be formatted using HTML elements such as lists, tables and images.

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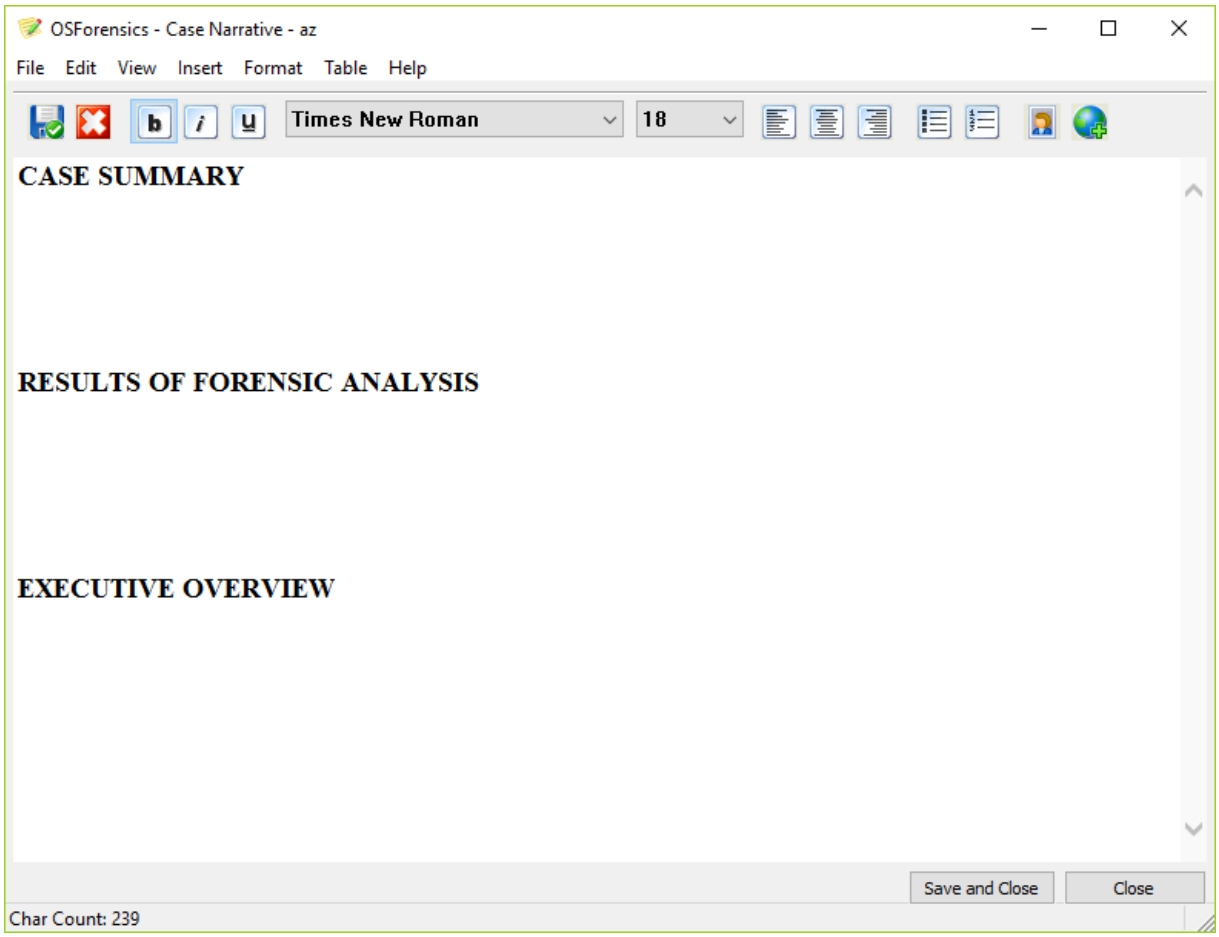


## Menu

**Save and Exit**
Save the current contents and exit the editor.

**Exit**
Exit the editor, if changes were detected, editor will prompt to user to save or discard changes.

**Text Style and Size**
Allows changing of supported text styles and fonts/fonts sizes.

**Text Alignment**
Right, Left or Center justify text in the editor.

**Bullets and List**
Start a new bullet-ed or numbered list.

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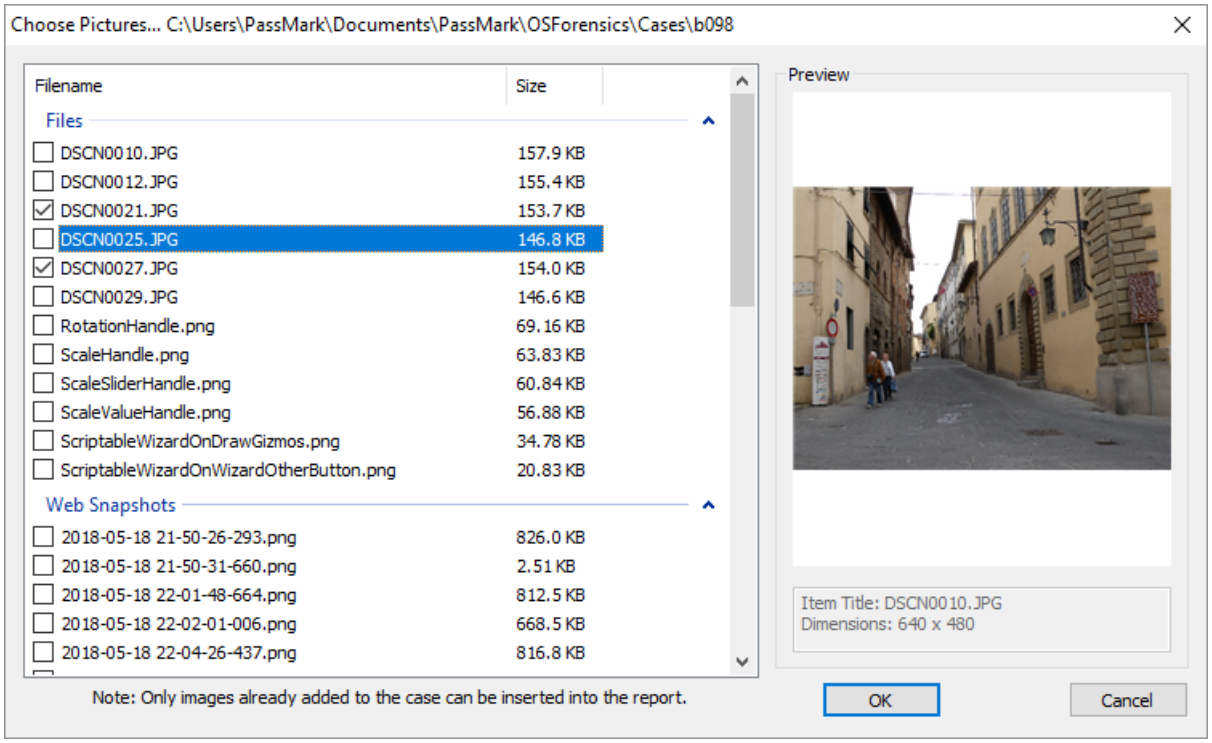
**Insert Images**
Will open a window to allow multiple selection of images already added to case to be included into the document.




## 5.4.4 Customizing Report Appearances

OSForensics generates reports as HTML web pages, which allows the style, layout and appearance to be modified with any web authoring application of your choice (or you can directly edit the HTML and CSS). Customizable elements include fonts, colors, and page layout.

Reports are generated using the fully customizable report templates included in the OSForensics install. The report templates can be found in the OSForensics Program Data folder.

There are several pre-installed report templates corresponding to a report type, which are stored as separate folders containing a set of template files. At the very minimum, a single HTML file, report.html, must exist in each folder which serves as the index page that OSForensics shall use to create the report. In addition, some templates also contain a set of additional HTML files corresponding to each section of the report (eg. files.html, deleted-files.html, notes.html). These files are required in order to generate working links to the corresponding sections via the report.html file.

You can include images (for company logos, headers or footers), CSS files, or JS files. All files in the folder will be copied across and included with the generated report.

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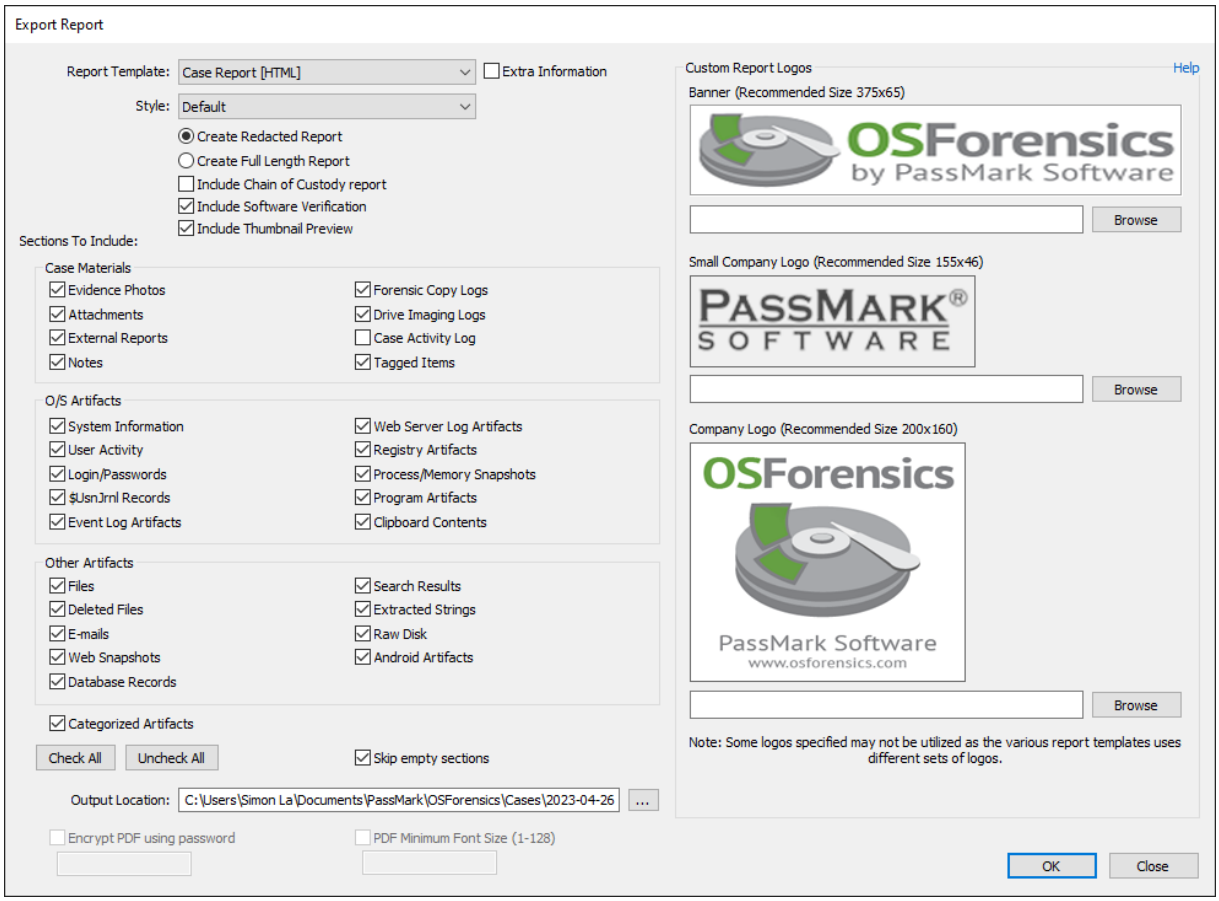


**Report Template**
List of report templates found in the Program Data folder that shall be used to generate the report.

**Style**
List of stylesheets available for the selected report template. Multiple styles can exist for each report and each CSS file in the report's folder will be listed as an available style. When creating the report, OSForensics will replace the HTML comment tag "<!--OSF_CSS_NAME-->" with the selected style name.

**Create Redacted Report**
Links to case items in the report. Does not include images in generated report directory.

**Create Full Length Report**
Copies case items in report into generate report folder. Links to newly copied items in report folder.

**Extra Information**
If checked, extra details such as MD5/SHA-1/SHA-256 hash values for each Case item shall be included in the report.

**Include Chain of Custody Report**
If checked, a Chain of Custody report will be exported along side the standard Case Report.

**Include Software Verification**
If checked, adds a signature page.

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**Include Thumbnail Preview**
If checked, image thumbnails are displayed where applicable.

**Custom Logos...**
Organization-specific logos and banners can be specified here to include in the report

**Sections to Include**
Specify the sections to include/exclude in the report. Each section corresponds to a specific category of items added to the case.

**Output Location**
Specify the location where the report files shall be generated.

**Generate PDF Copy in Output Location**
If supported by the report template, specifies whether a copy of the report shall be generated in PDF format in the output location.

## Editing HTML Template Files

The report templates can be found in the OSForensics Program Data folder, which is typically located in the following location:

```
C:\ProgramData\PassMark\OSForensics\ReportTemplates\ (Vista and newer)

C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\ReportTemplates\ (XP)
```

***NOTE:*** *All HTML template files must be saved in UTF-8 encoding (character set).*

The template HTML files are fully editable and are used to generate the final report files. OSForensics shall scan the template files for specific tags that correspond to a certain Case element, and replace it with the appropriate content. Depending on the report type, not all tags appear in the template. The following table summarizes the HTML comment tags that are recognized by OSForensics and replaced accordingly.

**IMPORTANT:** If any changes are made to the templates, make sure to keep a backup. Reinstalls and updates may overwrite previous changes.

| | |
|---|---|
| <!--OSF_CSS_NAME--> | This will be replaced with a reference to the selected style sheet. |
| <!--OSF_CASE_TITLE--> | This is the Case Name. |
| <!--OSF_CASE_INVESTIGATOR--> | This is the Investigator of the case. |
| <!--OSF_CASE_ORGANIZATION--> | This is the Organization details from the case. |
| <!--OSF_CASE_CONTACTDETAILS--> | This is the Contact details from the case. |
| <!--OSF_CASE_CUSTOMFIELD1_NAME--> | This is the name of the first custom field, if defined in the case. |
| <!--OSF_CASE_CUSTOMFIE | This is the value of the first custom field, if defined in the case. |

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| | |
|---|---|
| LD1_VALUE--> | |
| <!--OSF_CASE_CUSTOMFIELD2_NAME--> | This is the name of the second custom field, if defined in the case. |
| <!--OSF_CASE_CUSTOMFIELD2_VALUE--> | This is the value of the second custom field, if defined in the case. |
| <!--OSF_CASE_TIMEZONE--> | This is the Timezone from the case. |
| <!--OSF_CASE_DEFAULTDRIVE--> | This is the default drive selected in the case |
| <!--OSF_CASE_CASEFOLDER--> | This is the where the OSForensics case file is saved |
| <!--OSF_CASE_CASEDATE--> | This is the date that the case was created |
| <!--OSF_CASE_CASESHORTDATE--> | This is the date that the case was generated without timezone information . |
| <!--OSF_CASE_REPORTDATE--> | This is the date that the report was generated. |
| <!--OSF_CASE_REPORTSHORTDATE--> | This is the date the report was generated without timezone information. |
| <!--OSF_CASE_NARRATIVE--> | This is the Case Narrative for the case. |
| <!--OSF_CASE_OFFENSE--> | This is the Offense field for the case. |
| <!--OSF_CASE_ANALYSISREQBY--> | This is the Analysis Requested By field for the case. |
| <!--OSF_CASE_SUSPECTINFO--> | This is the Suspect's Name. |
| <!--OSF_CASE_SEIZEDDATE--> | This is the date that the evidence was seized. |
| <!--OSF_CASE_SEIZEDSHORTDATE--> | This is the date the evidence was seized without timezone information. |
| <!--OSF_CASE_LOCOFSEIZURE--> | This is the Location of Seizure for the case. |
| <!--OSF_CASE_LEGALAUTHORITY--> | This is the Legal Authority for Seizure for the case. |
| <!--OSF_CASE_SUMMARYOFJOB--> | This is the Summary of the Job for the case. |
| <!--OSF_CASE_EVIDENCEIMAGES--> | This table contains all evidence images added to the case |
| <!--OSF_CASE_ATTACHMENTSTABLE--> | This table contains all attachments added to the case. |

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| | |
|---|---|
| <!--OSF_CASE_NOTESTABLE--> | This table contains all notes added to the case. |
| <!--OSF_CASE_TAGGEDITEMS--> | This table contains all tagged items in the case. |
| <!--OSF_CASE_ACQUIREDIMAGES--> | This table contains the logs of images acquired using the Drive Imaging module that have been added to the case. |
| <!--OSF_CASE_FORENSICSCOPY--> | This table contains the logs of forensic copy operations that have been added to the case. |
| <!--OSF_CASE_EXTERNALREPORTS--> | This table contains all external reports that been added to the case. |
| <!--OSF_CASE_SYSINFO--> | This table contains all System Information reports that have been added to the case. |
| <!--OSF_CASE_USERACTIVITY--> | This table contains all User Activity scan results that have been added to the case. |
| <!--OSF_CASE_FILESEARCH--> | This table contains all File Name Search results that have been added to the case. |
| <!--OSF_CASE_DELETEDFILESEARCH--> | This table contains all Deleted File Search results that have been added to the case. |
| <!--OSF_CASE_INDEXSEARCH--> | This table contains all Index Search results that have been added to the case. |
| <!--OSF_CASE_MISMATCHSEARCH--> | This table contains all Mismatch Search results that have been added to the case. |
| <!--OSF_CASE_PROGRAMARTIFACTS--> | This table contains all Program Artifacts lists that have been added to the case. |
| <!--OSF_CASE_PASSWORDS--> | This table contains all Password retrieval scan results that have been added to the case. |
| <!--OSF_CASE_FILESTABLE--> | This table contains all files added to the case. |
| <!--OSF_CASE_UNDELETETABLE--> | This table contains all deleted files added to the case. |
| <!--OSF_CASE_EMAILS--> | This table contains all e-mails that have been added to the case. |
| <!--OSF_CASE_WEBSNAPSHOTS--> | This table contains all web snapshots that have been added to the case. |
| <!--OSF_CASE_REGISTRY--> | This table contains all registry keys that have been added to the case. |
| <!--OSF_CASE_ESEDBRECORDS--> | This table contains all ESEDB database records that have been added to the case. |
| <!--OSF_CASE_SQLITERECORDS--> | This table contains all SQLite database records that have been added to the case. |
| <!--OSF_CASE_THUMBDBR | This table contains all Thumbnail Cache database records that have been added to the case. |

| | |
|---|---|
| ECORDS--> | |
| <!--OSF_CASE_PROCSNAPSHOTS--> | This table contains all process snapshots that have been added to the case. |
| <!--OSF_CASE_MEMORYDUMP--> | This table contains all memory dumps that have been added to the case. |
| <!--OSF_CASE_STRINGLIST--> | This table contains all string lists extracted from the internal viewer that have been added to the case. |
| <!--OSF_CASE_PLISTRECORDS--> | This table contains all p-list properties and values that have been added to the case. |
| <!--OSF_CASE_NAVIGATION--> | This is where the navigation links to the different sections of the report shall be placed |
| <!--OSF_CASE_FOOTER--> | This is where the report footer shall be placed |
| <!--OSF_CASE_LOGO--> | This is where the company logo shall be placed |
| <!--OSF_CASE_LOGO_BANNER--> | This is where the banner logo shall be placed |
| <!--OSF_CASE_LOGO_COMPANY--> | This is where the small company logo shall be placed |

## Editing CSS (Cascading Style Sheets) Files

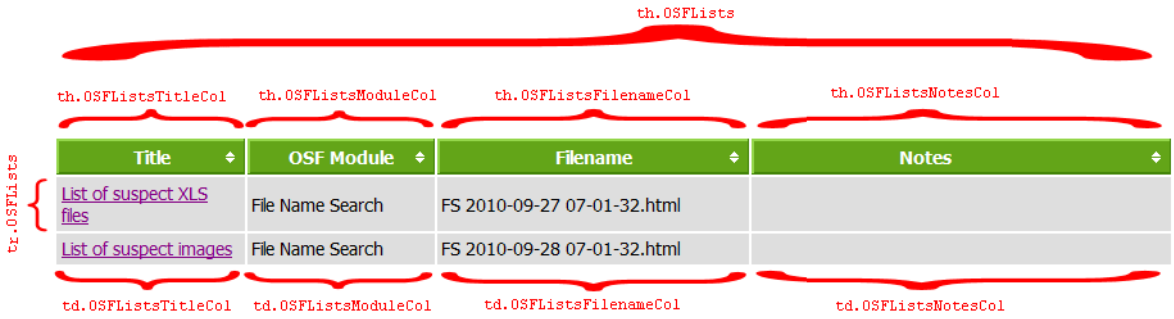
The fonts, colors and general appearance of the page, and in particular the tables in the report, are defined by CSS. If you are not familiar with CSS, you can take a look at the default templates supplied with OSForensics as reference (or simply make a copy of it, and modify it as you see fit).

Most of the CSS would be depending on the template file used and the markup of the HTML you place in the template.

However, the table for the items and the files are hard-coded but you can style them by their multiple class names.

Below is a reference example of the report table with the corresponding CSS class names in red and the {} braces indicate the sections of the table that they span.

### Lists table




### Files table

The other tables follow a similar naming convention.

### 5.4.5 Add Device

An investigator can specify storage devices to associate with a case. Once the device is added to the case, it can be accessed across all OSForensics functionality via a user-defined display name (similar to a drive letter in Windows).

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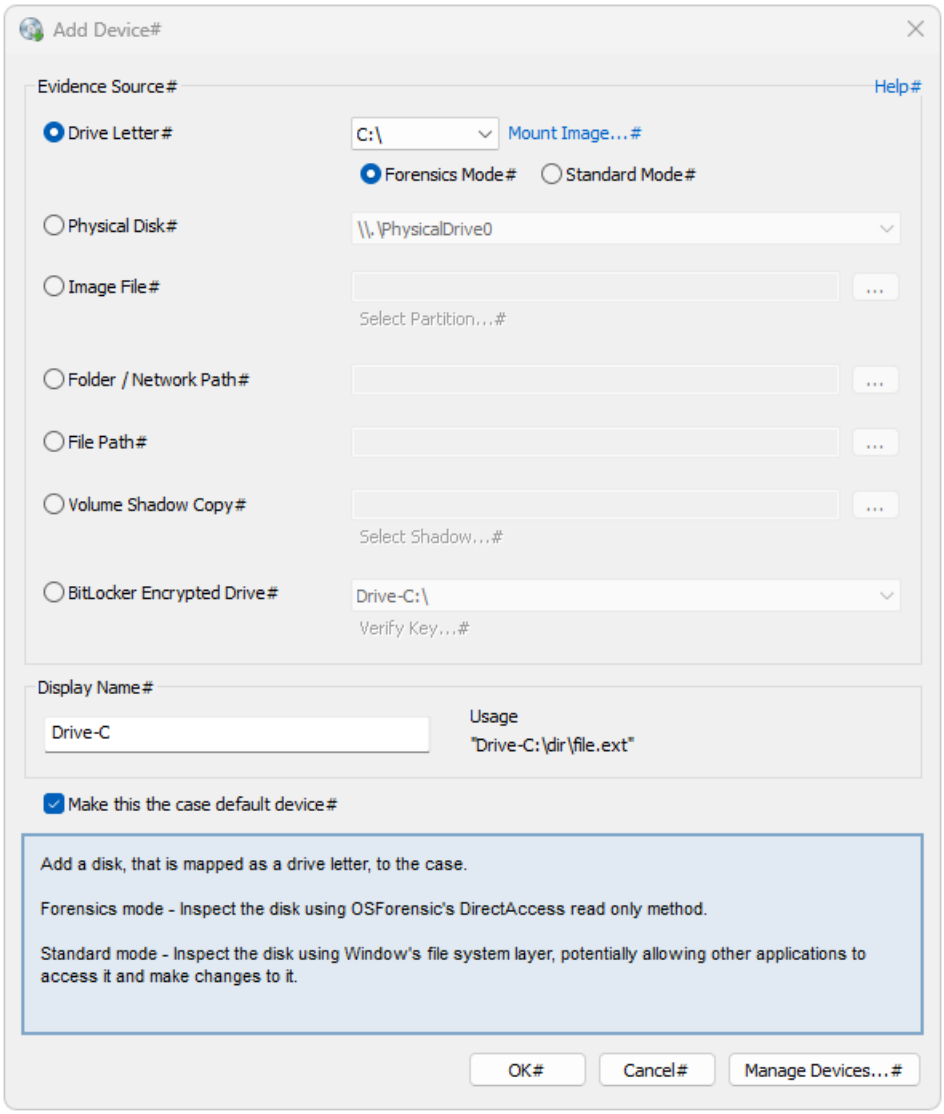


**Evidence Source**
The user chooses from the following types of devices to add to the case.

**Drive Letter**
Add a device associated with a Windows drive letter to the case. The 'Mount Image...' link opens OSFMount for mounting image files to a drive letter.

*Forensics mode* - The file system is accessed via OSForensic's own file system layer, bypassing normal Window file management mechanisms. This allows for deeper analysis of file system objects (eg. NTFS metafiles), bypassing permissions, and ability to see files not visible in Windows (eg. rootkit files). However, operations on the drive are slower.

*Standard mode* - The file system is accessed via Windows file system layer (ie. explorer-like access to files). This mode is quicker but does not have the same depth of access as in Forensics mode.

**Physical Disk**

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Add an entire physical disk or partition attached to the system to the case. This allows access to partitions that are normally inaccessible in Windows such as hidden, unnamed or unsupported (Linux/Mac) partitions. Physical disk partitions are accessed in Forensics mode since they are not normally accessible in Windows.

If the entire physical disk is added to the case, the contained partitions appear as subfolders of the device as shown below.

If recovered partitions are found on the disk, they can also be added to the case.

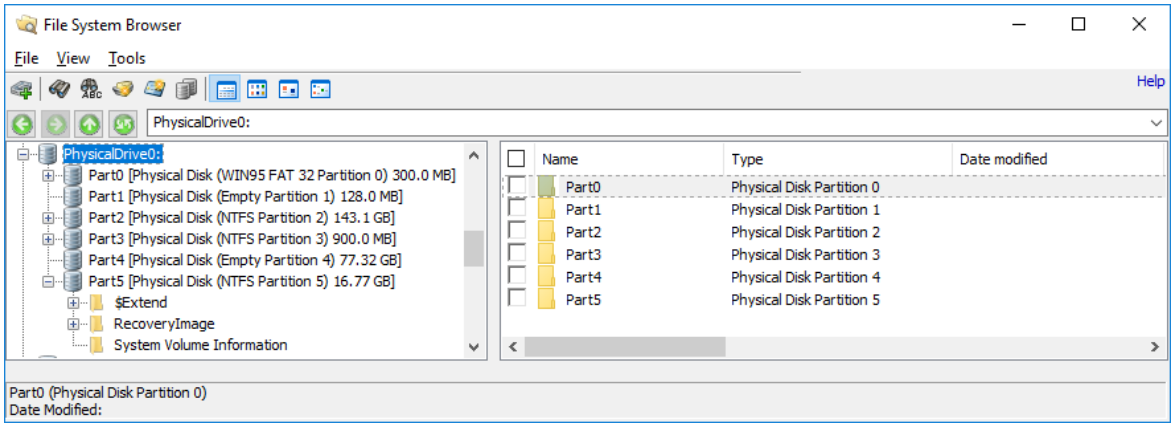
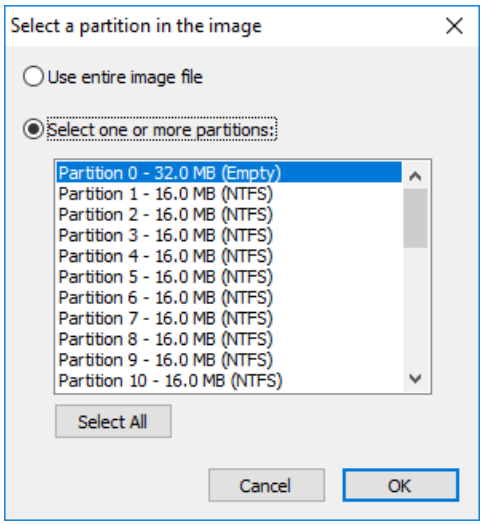



**Image File**
Add an image file of a physical disk or partition to the case. The image file can contain a single volume or multiple partitions under a supported partition scheme. Image files are accessed in Forensics mode since they are not normally accessible in Windows. *See Supported Image Formats for a list of image file formats that are supported.*

To add individual partitions to the case, click on the 'Select Partition...' link.




One or more partitions can be added to the case by selecting the desired partitions. These partitions shall be added as individual devices to the case.

Recovered partitions, if found on the image file, can also be selected.

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If the entire image file is added to the case, it will appear as a single device in the case. Any contained partitions appear as subfolders of the device, similar to adding an entire physical disk.

**Folder / Network Path**
Add a folder or network path to the case. Folder/network paths are accessed in Standard mode (ie. Windows file system layer) since the physical medium of such paths are not accessible.

**File Path**
Add a single file path to the case. File paths are accessed in Standard mode (ie. Windows file system layer) since the physical medium of such paths are not accessible.

**Volume Shadow Copy**
Add a Volume Shadow Copy for a supported NTFS volume. Shadow copies are backup copies of data on a specific volume at a specific point in time. Shadow Copies are accessed in Forensic mode since they are not normally accessible in Windows. See Support for Volume Shadow Copy for more information.

**BitLocker Encrypted Drive**
Add an existing Case Device that is BitLocker encrypted to access the drive in decrypted, raw form. See Support for BitLocker Encrypted Drives for more information.

**Display Name**
The user specifies a unique display name to assign to the device. The name must be 2-32 characters long, and must not contain any special characters. Once the device has successfully been added, its display name can be used to reference the device using the following syntax:

*<display_name>:*

*Eg. dell-pc-vista:*

**Make this the case default device**
When checked, the mounted device is set to the case's default device when successfully mounted.

**Manage Devices**
Manage all devices that have been added to the case.

#### 5.4.5.1 Supported Image Formats

The following is a list of image formats supported by OSForensics when adding an image file to a case:

- Raw Image (.IMG, .DD)
- Raw CD Image (.ISO, .BIN)
- Split Raw Image (.00n)
- Advanced Forensics Format* (.AFF, .AFD, .AFM)
- VMWare Image (.VMDK)
- EnCase Image (.E01, .Ex01)
- EnCase Logical Image (.L01, .Lx01)
- SMART Image (.S01)
- VHD Image (.VHD)

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- Advanced Forensics File Format 4 (.aff4)

*The supported version of Advanced Forensics Format is AFFv3 with zlib compression support. Encryption and signatures are not supported.

#### 5.4.5.2 Supported File Systems

The following is a list of file systems supported by OSForensics when adding a device to the case in Forensics mode:

- NTFS (Windows) *
- FAT16/FAT32 (DOS/Windows)
- exFAT (Windows)
- Ext2/Ext3/Ext4 (Linux/Android)**
- HFS+/HFSX (Mac/iPhone/iPad)
- APFS (MacOS, iOS, tvOS, watchOS, audioOS)***

* NTFS Compression is supported. Windows 10 'CompactOS' (ie. 'System Compression') is supported for the XPRESS compression format. LZX compression is not yet supported.

**In some of the more popular Linux distributions (eg. Fedora, Gentoo, Ubuntu), the Logical Volume Manager (LVM) manages the volumes in the system. This allows for a single, continuous volume to be backed by one or more physical disk partitions for ease of management. However, when the physical disks are imaged, the partitions appear as an 'LVM partitions' containing metadata regarding how the partitions are arranged into the single volume. OSForensics is unable to rearrange the partitions back into the single volume. To resolve this issue, an image of the volume must be created under Linux so that the operating system handles the complexity of the LVM layer. This resulting image can then be added to the case as it appears to OSForensics as a standard Linux volume.

*** APFS support is experimental. Not all functionality supported by the file system may work properly. ZLIB and LZVN compression are supported.

#### 5.4.5.3 Supported Partitioning Schemes

The following is a list of partitioning schemes supported by OSForensics when adding a device to the case:

- Master Boot Record (MBR)
- GUID Partition Table (GPT)
- Apple Partition Map (APM)

#### 5.4.5.4 Support for Volume Shadow Copy

## Background

The Volume Shadow Copy Service is a backup technology from Microsoft used in Windows XP and later operating systems. It is a mechanism for creating consistent point in time copies of data know as shadow copies. Shadow copy technology requires the file system to be NTFS. Shadow copies are stored on the volume and can be used to reconstruct the volume to a previous point in time.

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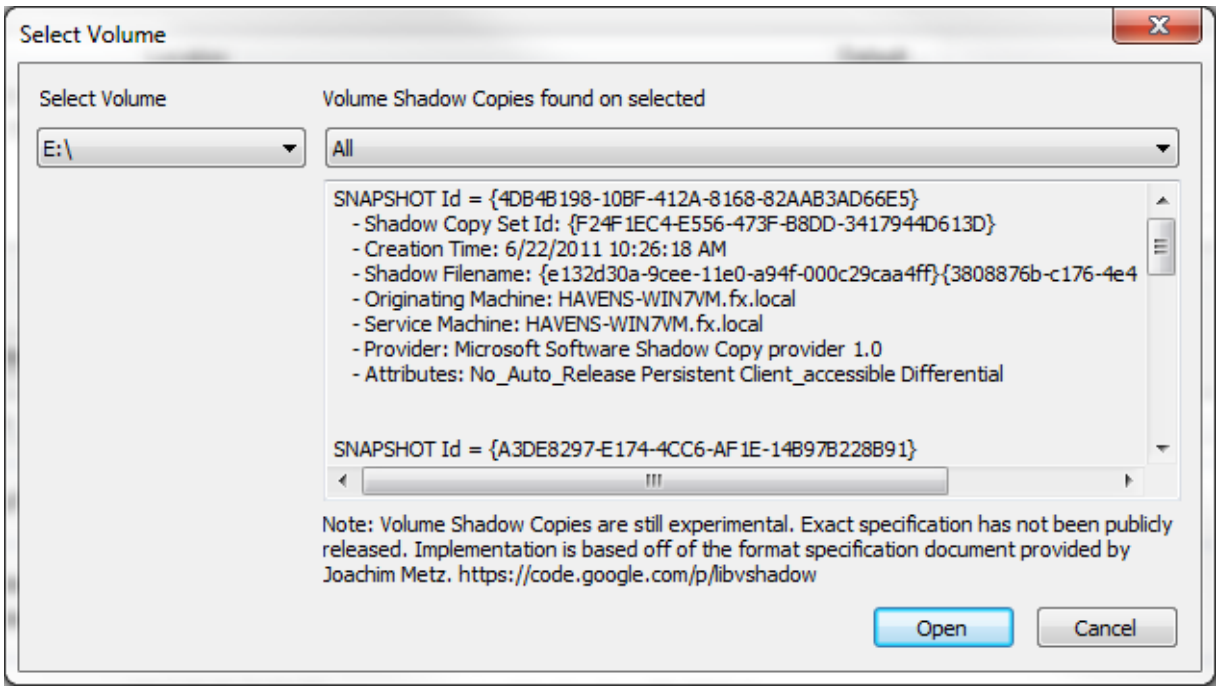
## Usage

Shadow Copies can be added to the case and used in various OSForensics modules. Shadow copies are loaded on first use. The time to load a shadow copy is dependent on the number of shadow copies existing on the volume and the size of the copies themselves. This means for larger drives, the time to load can be quite substantial. Shadow copies changes are stacked, in the sense to access the oldest shadow copy, the more recent shadow copies must first be applied to the volume. To decrease the time needed to access shadow copies, OSForensics can cache up to 10 volume's set of shadow data in memory (i.e. if drive E:\ has 4 shadow copies, the entire set will count as one toward the 10 limit).




### Analyze Volume Shadow Copies

OSForensics provides a tool to find changes in files and directories between two shadow copies of a single volume. By comparing the signature between two shadow copies, files that have been created, deleted or modified can be determined within the period of when the snapshots were taken.

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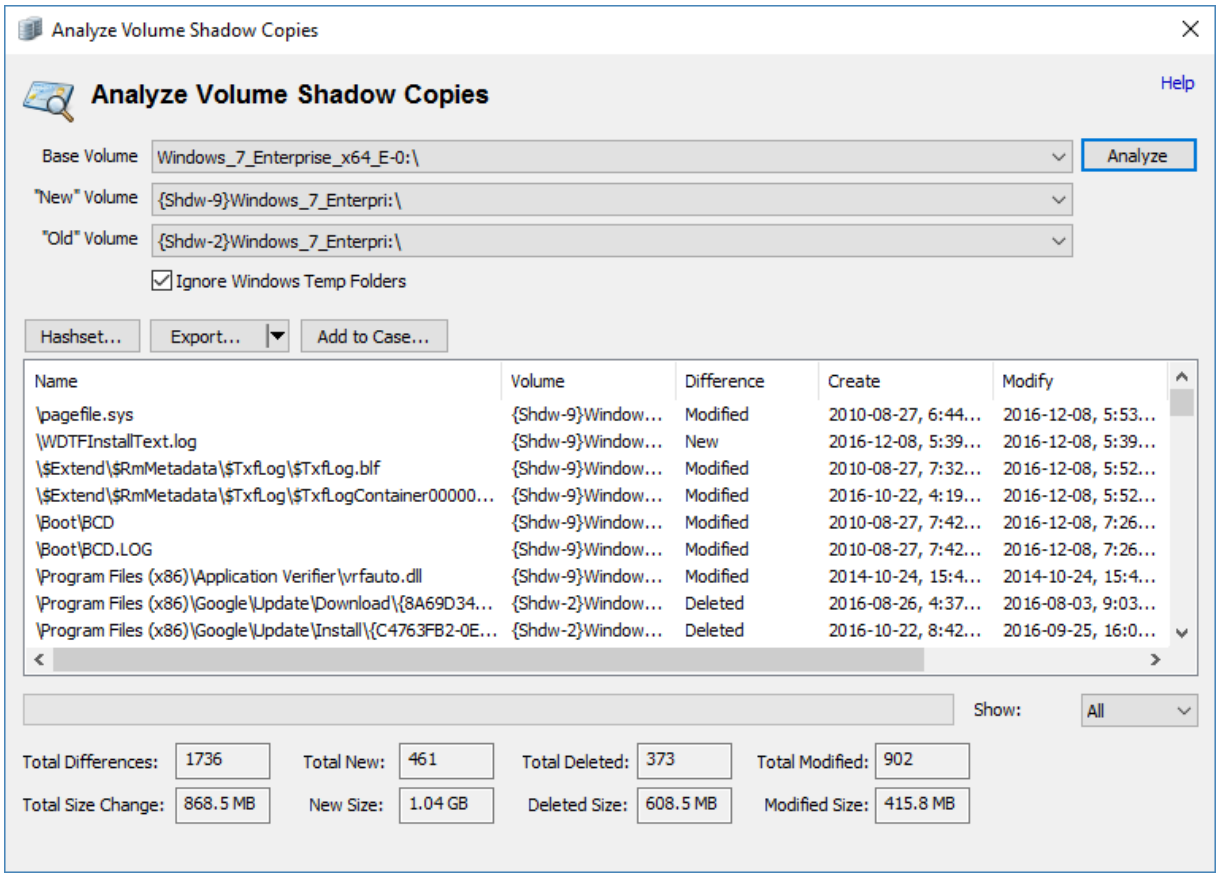


**Hashset**
Create a hashset that includes all files in the comparison result.

**Export**
Export the comparison results to a text, CSV or HTML file

**Add to Case**
Add the comparison results to case as an CSV or HTML file

### File System Browser

The File System Browser can display multiple shadow copy versions of a file alongside the most current version. See Shadow Copies for details on its usage.

## Implementation & Limitation

The specification of the Volume Shadow Copy has not been publicly released by Microsoft. Implementation for Volume shadow copies is based on the work of Joachim Metz's document Volume Shadow Snapshot (VSS)[1].

[1]libvshadow - Library and tools to support the Volume Shadow Snapshot (VSS) format. Version 0.0.10. Obtained on March 6, 2013

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#### 5.4.5.5 Support for BitLocker Encrypted Drives

OSForensics is capable of accessing images or drives that are encrypted using BitLocker, provided that a valid key is specified. The following key protectors can be used to unlock a drive:

- Password
- Recovery Key *(eg. 531135-570372-522236-480007-142241-640487-244519-333049)*
- Startup Key File *(.bek file)*

OSForensics supports the following encryption algorithms BitLocker uses to encrypt the drive:

- AES-CBC 128-bit encryption with diffuser
- AES-CBC 256-bit encryption with diffuser
- AES-CBC 128-bit encryption
- AES-CBC 256-bit encryption
- AES-XTS 128-bit encryption
- AES-XTS 256-bit encryption

## Usage

To add a BitLocker encrypted drive to the case, the image file or disk must first be added in his encrypted form. For example, an Encase image file of a BitLocker encrypted drive, *bitlocker.e01*, is first added to the case.

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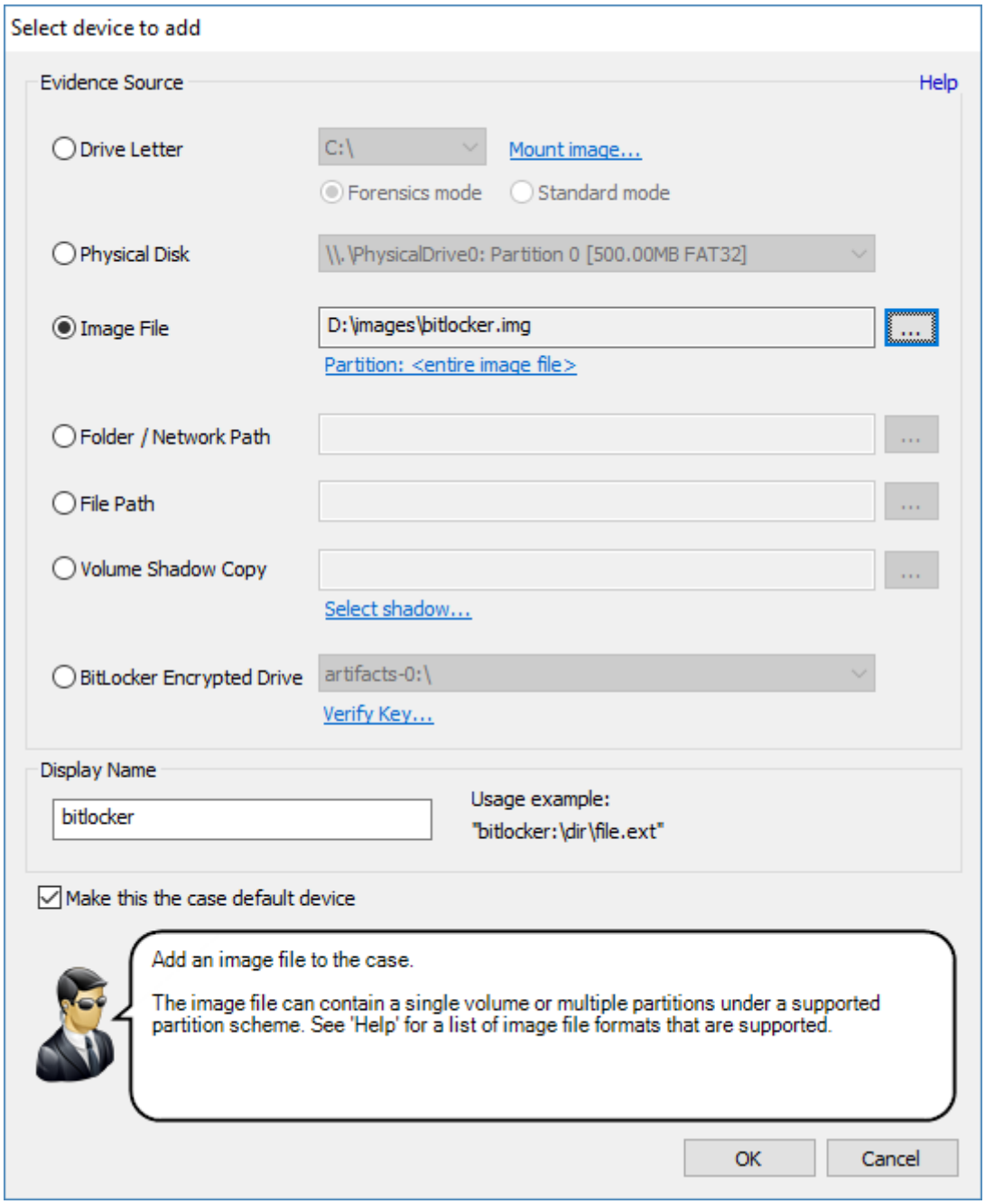


Because the image file is encrypted, performing forensic analysis on this device is not very useful. To access the drive in decrypted form, a "BitLocker Drive" device must be added to the case on top of the image file device. Open the Add Device dialog and select 'BitLocker Encrypted Drive'. Select the previously added image file device from the drop down list.

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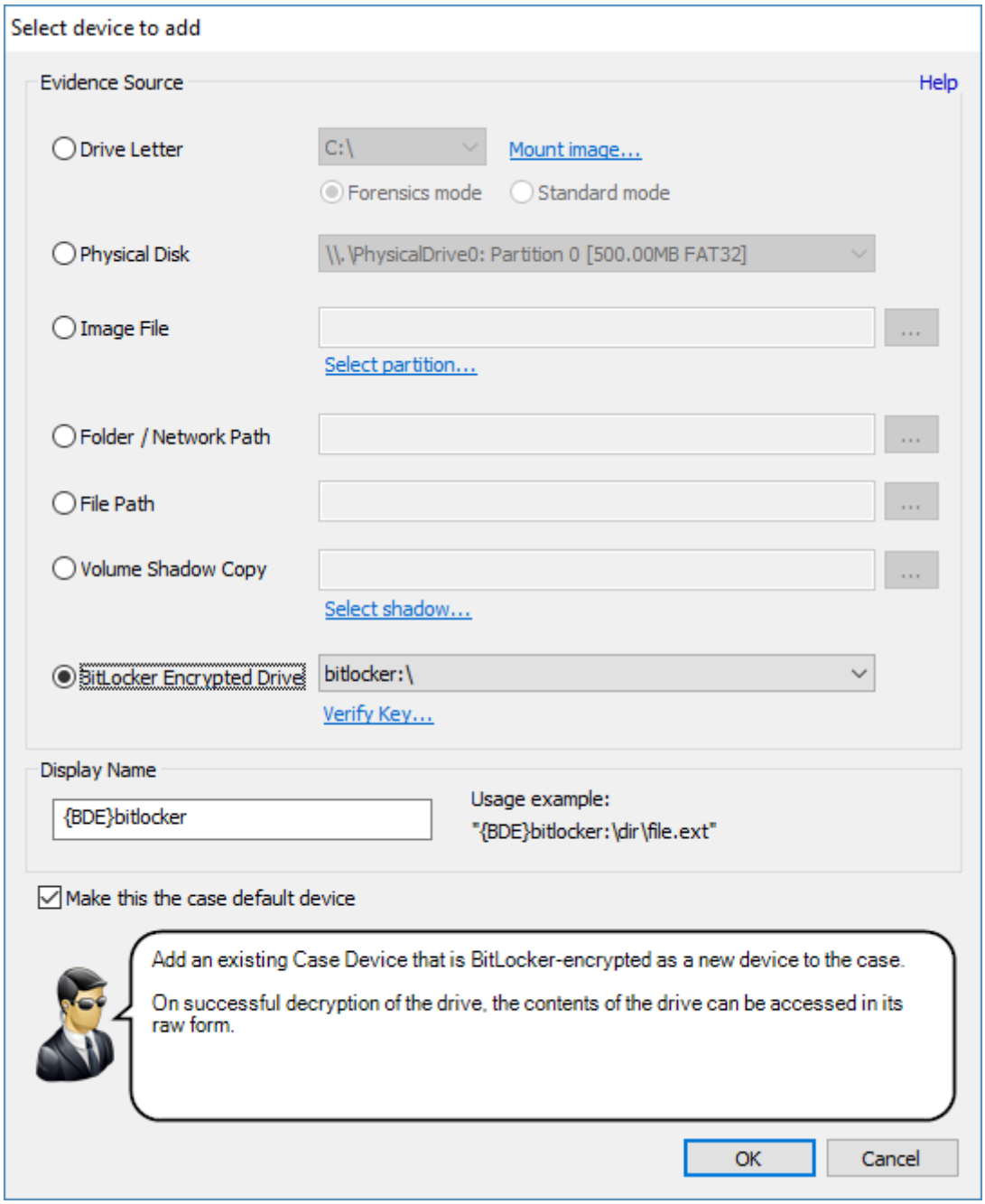


To verify whether the drive can be decrypted, click on 'Verify Key...' to specify the key needed to unlock the drive.

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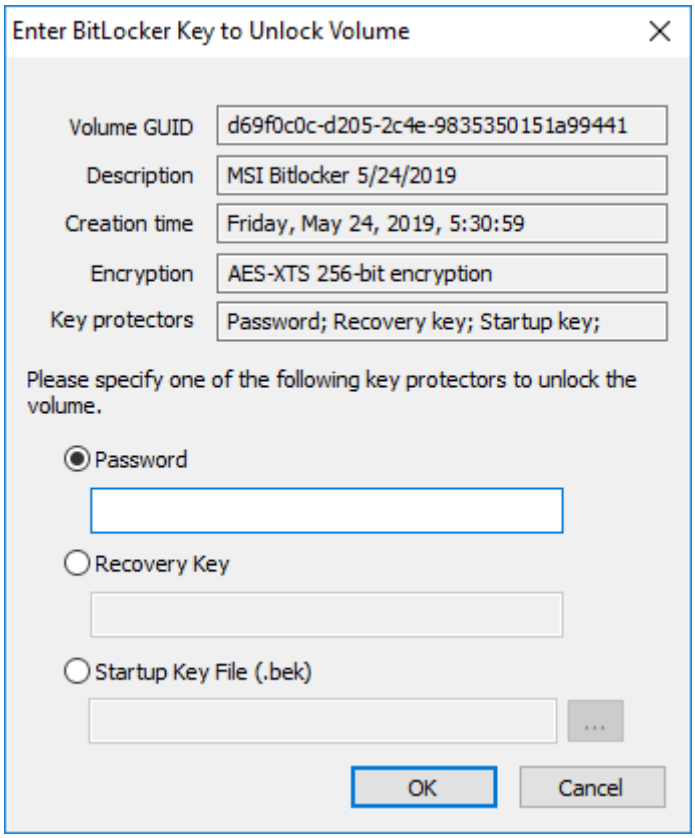


Select one of the key protectors to use and enter the corresponding key for the drive. The list of key protectors that can be used to unlock the drive is listed in the *Key protectors* field. Key protectors that cannot be used to unlocked the drive are disabled.

Upon successful key verification, click OK in the Add Device dialog to add the device to case. After entering the key one more time, the device should be accessible via any OSForensics module in decrypted form.

### 5.4.6 Manage Devices

The Manage Devices window displays the list of devices added to the case.

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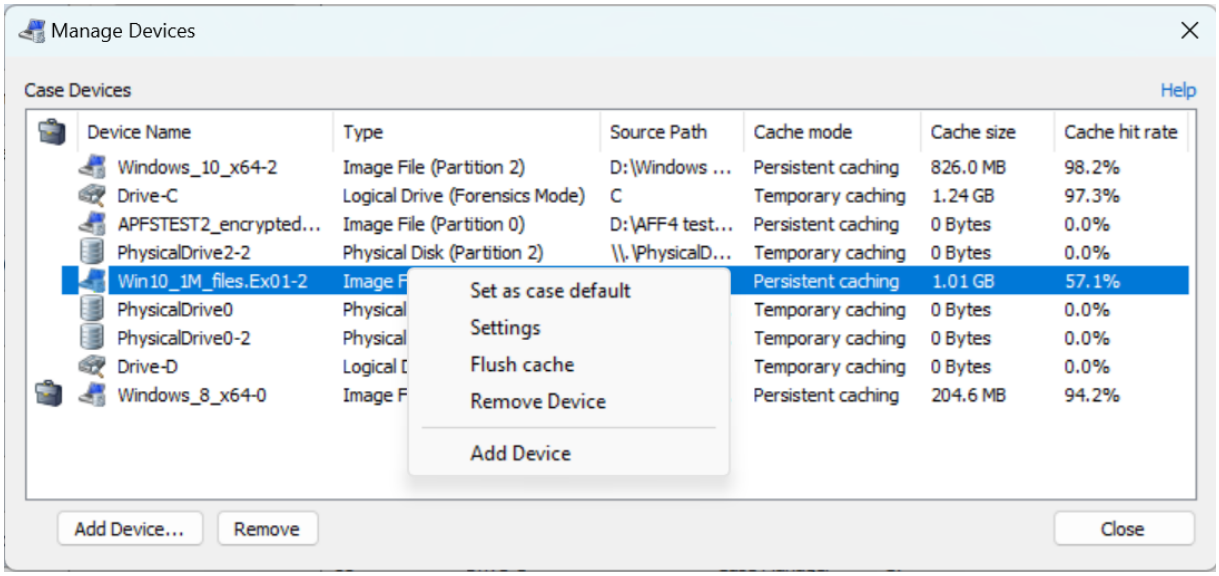


**Device Name**
The name used to reference the device

**Type**
One of the following devices types: Image File, Logical Drive, Physical Disk, File System Path (UNC), Volume Shadow, Bitlocker-encrypted Drive

**Source Path**
The path of the source image, disk or path backing the device

**Cache mode**
The caching mode of the device

**Cache size**
The size of the device cache data stored in memory

**Cache hit rate**
The success rate of accessing data from the device cache. If the data is not found in cache, it is accessed directly from the underlying source disk.

# Usage

**Add Device...**
Add a new storage device to the case.

**Remove**
Remove the selected devices from the case. *Note: Any paths that refer to the device name (eg. tags) would no longer be valid.*

## Right-Click Menu

**Set as case default**
Specify the selected device as the case default drive

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**Settings**
Modify the selected device settings

**Flush cache**
Clear the cache data for the selected device

**Remove device**
Remove the selected device from the case. *Note: Any paths that refer to the device name (eg. tags) would no longer be valid*

**Add Device...**
Add a new storage device to the case.

#### 5.4.6.1 Device Caching

Device caching is used to optimize the performance of file system accesses, reducing the time required to perform forensic scans of disks. Devices can be configured with one of the following caching modes:

- Persistent caching
- Temporary caching
- Caching disabled

*Note: Caching mode settings are only valid for image files, drives (forensic mode) and physical disks that are accessed via OSForensics' file system layer (as opposed to the Windows File System API).*

### Persistent Caching

Persistent caching mode stores data read from the underlying disk in RAM and persists while the case is opened, maximizing speed while performing forensic scans. After running an initial scan to populate the cache, subsequent scans complete in a shorter amount of time. This is the default mode for image files as the file system data cannot be modified. However, for live disks such as volumes mounted as drive letters or physical disks, the forensic scan results may contain stale data as there is a possibility of file system data being modified during the scan.

### Temporary Caching

Temporary caching mode, like persistent caching, stores data read from disk in RAM for quick access. However, the main difference is that the cache is flushed before each scan, reducing the amount of stale data in the results. This is the default mode for live disks such as drive letters and physical disks as the file system is likely to be modified while scans are being performed. If the disk is known to be read-only or seldomly modified, changing to persistent caching mode can optimize performance.

### Caching Disabled

Caching can be disabled to prevent data read from disk to be cached. This is not recommended for most users. However, this mode may be useful in rare circumstances such as for debugging purposes or if the file system is constantly modified and the most up-to-date results are required.

#### 5.4.6.2 Device Settings

The behaviour of devices added to a case can be modified from the Device Settings dialog, which can be accessed from Manage Devices or Case Manager

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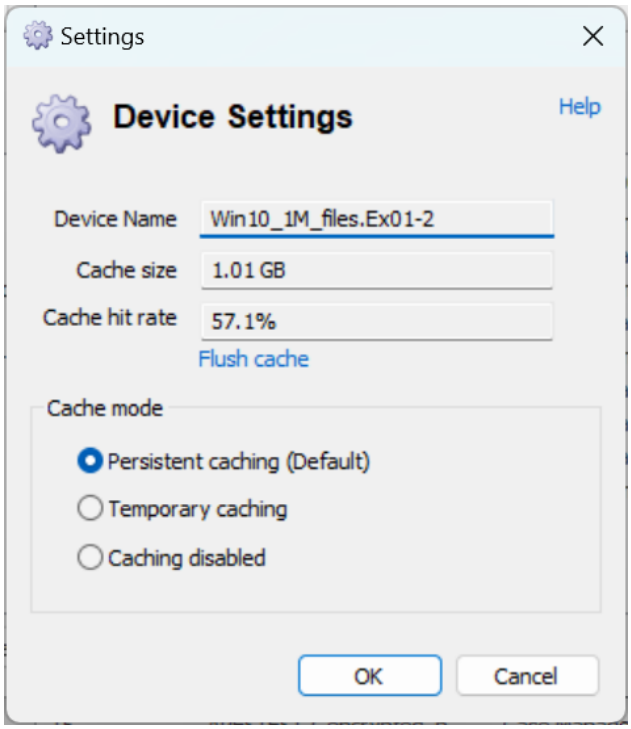


**Flush cache**
Clear the cache data for the device from RAM

**Cache mode**
Change the caching behaviour for the device

### 5.4.7 Case Activity Log

When performing forensic investigations, it is important to maintain an audit trail of the exact activities carried out during the course of the investigation for several purposes including the following:

- Debriefing of a completed investigation
- Auditing the activities of an investigation to determine whether proper procedures and protocols were followed
- Educating and evaluating of investigators in training

OSForensics provides the option to specify whether activities performed in the case should be automatically logged to a tamper-resistant log file on disk, producing a trace of all actions performed during the investigation.

## Enable/Disable Logging

Logging can be enabled/disabled when creating a case for the first time or when editing an existing case in the Case Management window

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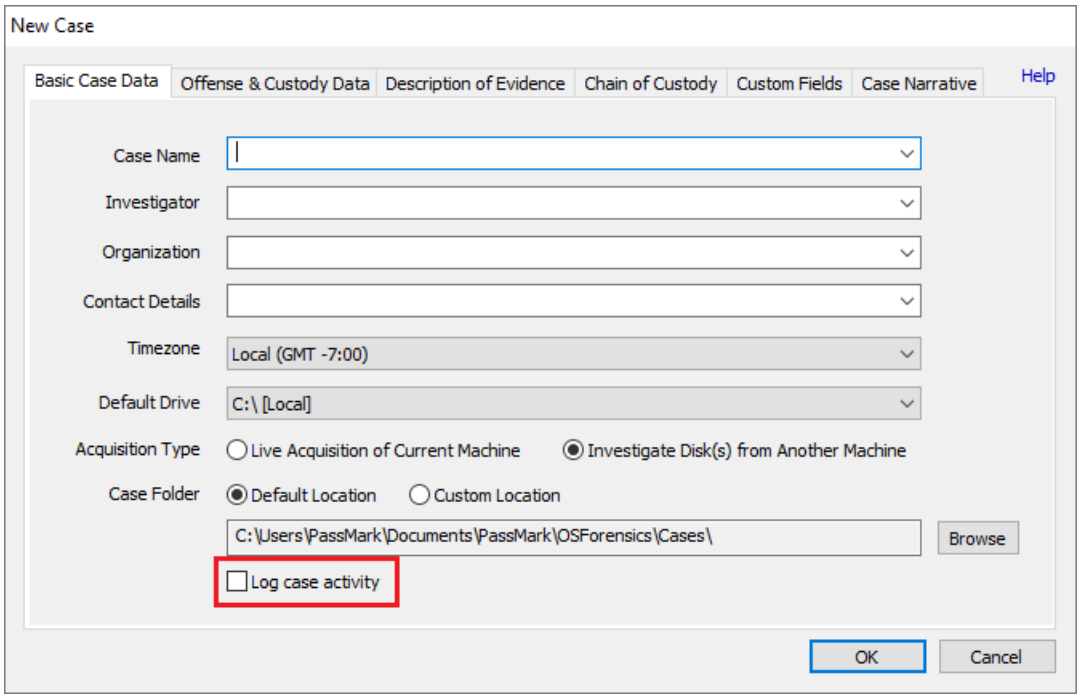
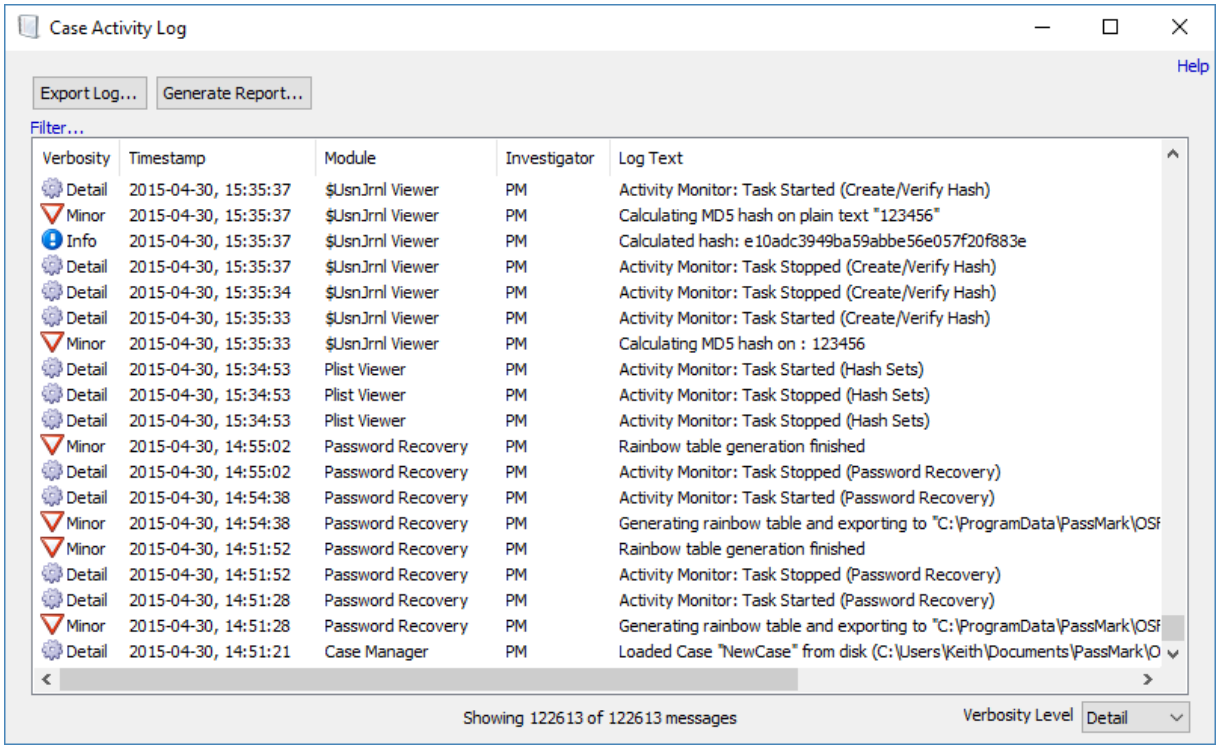



## Viewing the Log

Once logging is enabled, the log can be viewed by clicking the "View Log" button in the Case Management window, as well as the "View Log" icon in the "Case Management" group under the Start tab.

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The log window displays a list of log entries ordered chronologically. The verbosity of the displayed log entries can be changed by selecting one of the following verbosity levels, from lowest to highest:

- **Major** - *Includes all major activity related to the case itself, such as when it is first created.*
- **Minor** - *Includes start/completion of all significant forensics activity, such as file name searching, index creation, deleted file searching, etc.*
- **Info** - *Includes all supplemental forensics activity performed, such as exporting results to disk, adding files to case, etc.*
- **Detail** - *Includes details of the subtasks that are being executed internally while major forensics operations are being performed.*

Selecting a verbosity level will include all log entries marked with the specified verbosity level and lower. For example, selecting 'Minor' will include all log entries that are marked as 'Major' or 'Minor'.

**Filter...**
Clicking on the "Filter" link allows the investigator to filter the log entries by module.

**Export Log...**
Export the log to a text or CSV file

**Generate Report...**
Generate an HTML or PDF report of the log

## Tamper-resistant Log File

To maintain the integrity of a case's recorded history, the log file has built-in security mechanisms for verifying whether or not it has been tampered with. The log file itself is stored in an encrypted format and can only be viewed when the case is opened within OSForensics; it cannot be viewed as-is using a text viewer like Notepad or when another case is opened in OSForensics. In order to prevent log entries from being inserted, removed, or re-ordered, each log entry is encrypted using a key linked to previous log entries. This key is destroyed immediately after the log entry is written. In addition, several layers of integrity checks (ie. hash chains) are computed for each log entry that serves to verify the integrity of all previous log entries.

*Note: The security mechanisms in place cannot prevent a user from corrupting or deleting the log file; it can only detect whether or not the contents of the log file have been compromised. Once the log file has been tampered with, the contents may or may not be recoverable. That is why it is always a good idea to make periodic backups of your case files.*

### 5.4.8 Case Item Properties

Details list view will show the EXIF metadata information for the Case Items in the Files category if the "Include EXIF Metadata" option is checked when the item is added to the case.

**Select EXIF Tags to Include in the Case Report**

Different list of tags can be selected for different file types for the case report generation.

e.g.
For JPG file type, include tags:
[EXIF] Make
[EXIF] Camera Model Name
[Composite] Lens ID

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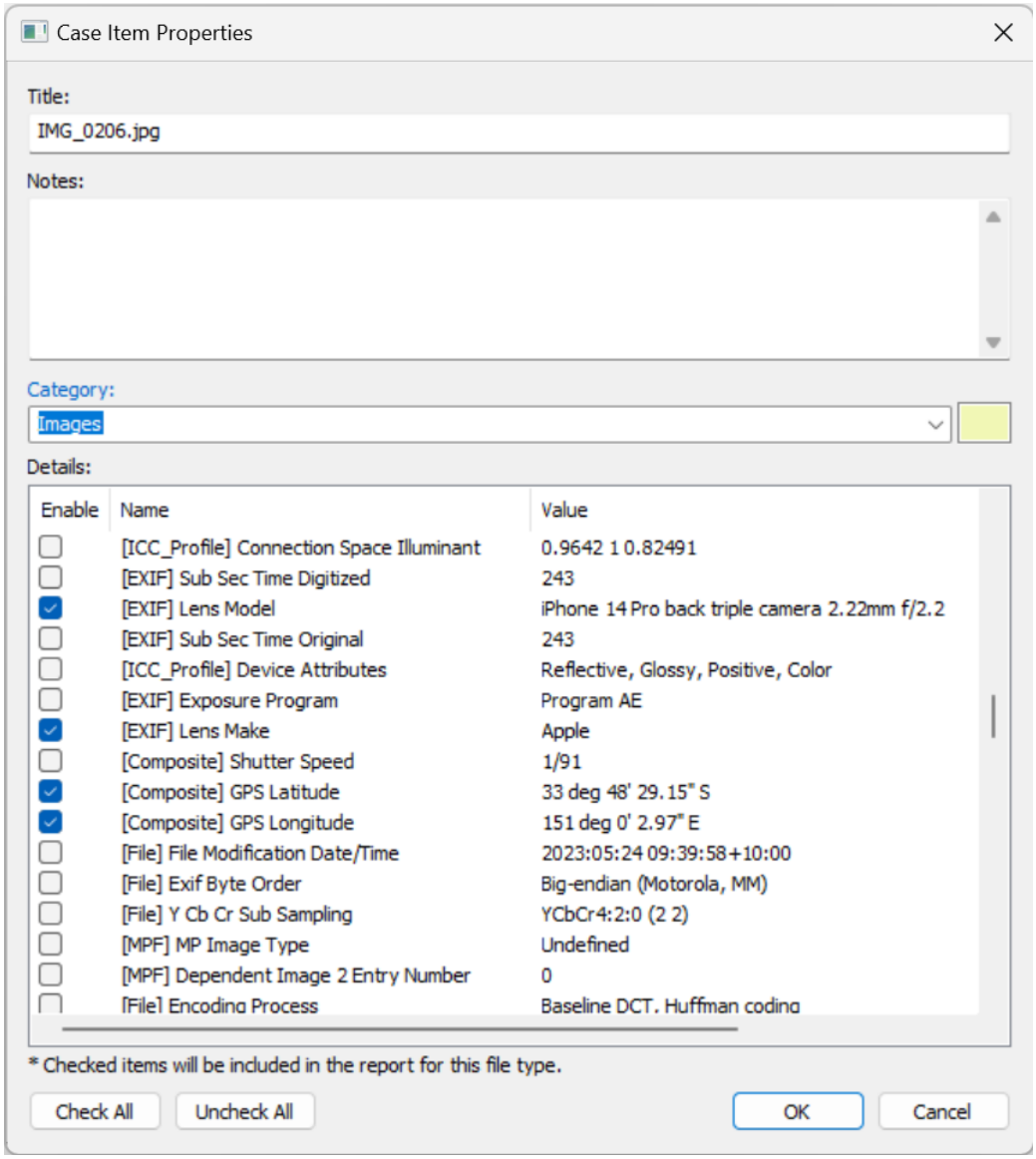
[Composite] GPS Latitude
[Composite] GPS Longitude

But for MOV file type, will include tags:
[EXIF] Make
[EXIF] Lens Make
[EXIF] Lens Model
[Composite] Lens ID

This can be configured in the Manage Case > Case Items, by selecting Properties right-click option. Check/uncheck the tags will enable/disable the tags for the case report generation.




## 5.5 Clipboard Viewer

The Clipboard Viewer allows the investigator to browse the contents stored in the clipboard on the live system, which can contain forensic artifacts of interest such as passwords, images, or contraband files.

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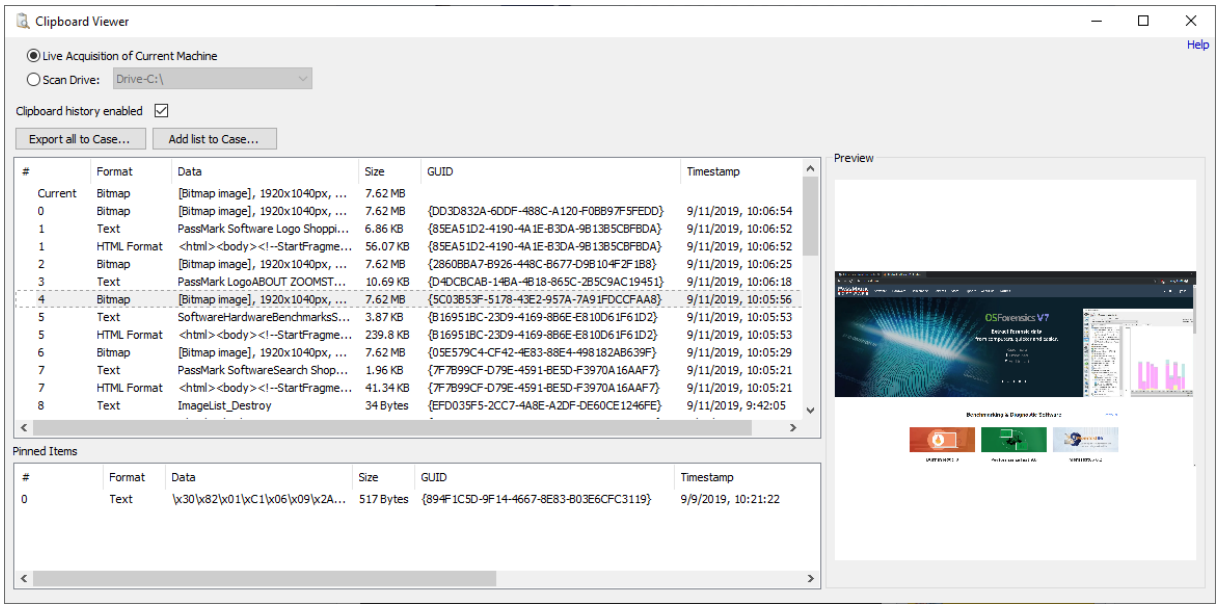
In newer versions of Windows, a clipboard history is available which can provide as many as 25 items that have been previously added to the clipboard. In addition, if an item is "pinned" to the clipboard, the data will persist on disk even on reboot or shutdown.



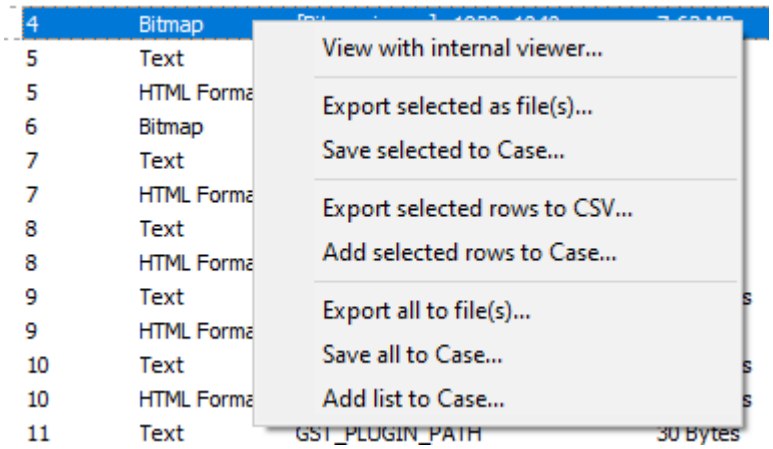

## Usage

To view the clipboard contents of the live system, select 'Live Acquisition of Current Machine'. Selecting a disk via 'Scan Drive' is also possible, but only "pinned" items stored on disk shall be displayed.

The data that is currently stored in clipboard is indicated by 'Current'. If clipboard history is enabled, the items in the history shall also be displayed in the list. Select an item to see a preview of its contents on the right pane.

Double-clicking or pressing 'Enter' on a thumbnail opens the internal viewer.

### Right-click Menu




**View with Internal Viewer...**

Opens the clipboard item with OSForensics Viewer to perform a more thorough analysis. *Keyboard shortcut: Enter*

**Export selected as file(s)...**
Prompts the user to enter a location on disk to save the selected clipboard item(s)

**Save selected to Case...**
Opens a dialog prompting the user to enter details for exporting selected clipboard item(s) as files to the case

**Export selected rows to CSV...**
Prompts the user to enter a location on disk to save the list of selected clipboard item(s) to CSV

**Added selected rows to Case...**
Opens a dialog prompting the user to enter details for exporting a list of selected clipboard item(s) as a CSV file to the case

**Export all to file(s)...**
Prompts the user to enter a location on disk to save all clipboard item(s)

**Save all to Case...**
Opens a dialog prompting the user to enter details for exporting all clipboard item(s) to the case

**Add list to Case...**
Opens a dialog prompting the user to enter details for exporting a list of all clipboard item(s) as a CSV file to the case

## Additional Info

### Pinned Items

In newer versions of Windows with clipboard history enabled, items can be pinned so that will persist on disk even on reboot or shutdown. When scanning for drives (ie. non-live acquisition), only pinned items shall be displayed, if available. However, the contents of the pinned item is encrypted on disk and can only be displayed in unencrypted form (in the main list of clipboard items) when logged in as the proper user.

# 5.6 Deleted Files Search

The Deleted Files Search Module can be used to recover files deleted from the file system (ie. deleted file no longer in recycling bin). This is especially useful for recovering files that the user may have attempted to destroy.

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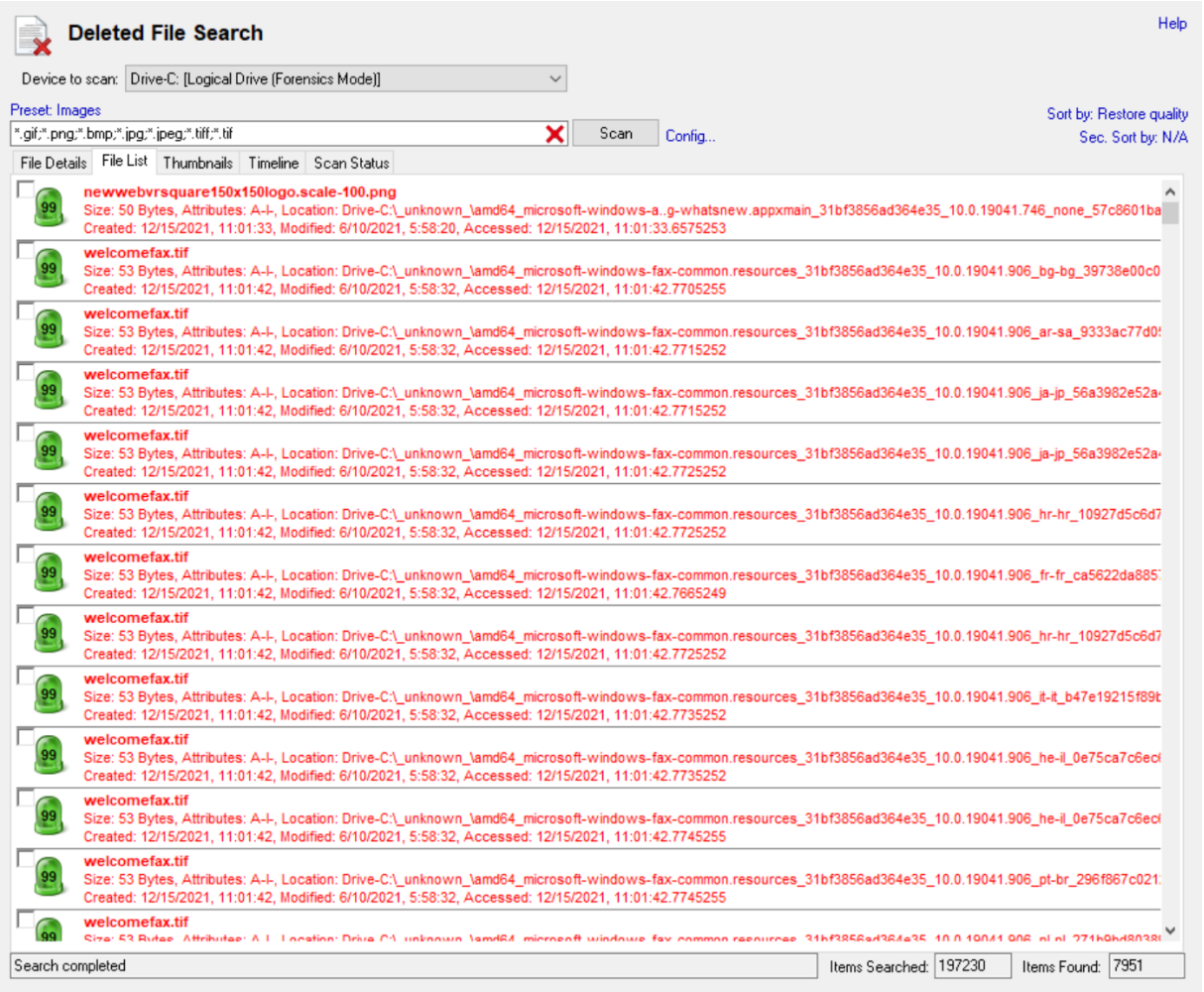


## Basic Usage

A basic deleted file search simply involves entering a search string and selecting a device to scan. OSForensics will scan through the selected disk for traces of deleted files that contain the search string within their name. The basic search is case insensitive.

Recovered partitions, if found on the disk, can also be scanned for deleted files.

**Presets**
You can select one of the preset search options to quickly locate image files or office documents.

**Multiple Searches**
To run multiple different searches at once by separating the terms with the ';' character.

**Wildcards**
You can use '*' or '?' as wildcards within the search string.

'*' represents any number of characters
'?' represents a single character

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If a wildcard is entered anywhere in the search field, wildcard matching is enabled on all search terms. When wildcard matching is enabled, you will need to explicitly add '*' to the start and end of the search term if you are trying match a word that may appear in the middle of a filename. '*' to the start and end of the term if you are trying match a word that may appear in the middle of a filename.

## More Advanced Options

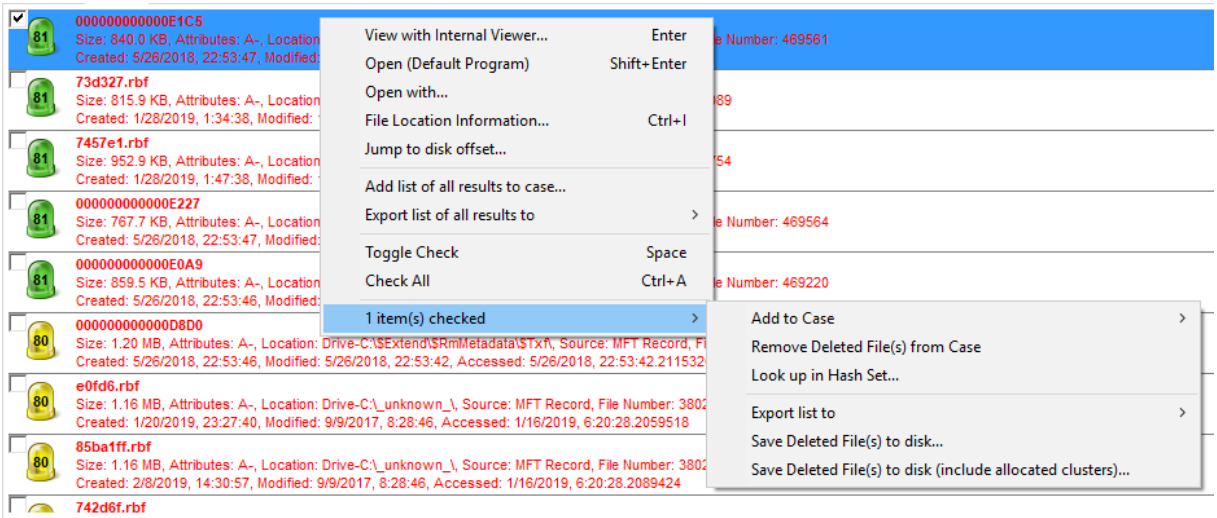
By clicking the *Config...* button you will be taken to the Deleted Files Search Configuration window where more advanced options can be selected.

## Results

The results of the search are displayed in one of several views, along with a summary of the number of items searched/found. The File List view contains a list of file names, along with the corresponding metadata and a quality indicator between 0-100. A value close to 100 means that the deleted file is largely in tact, with only a few missing clusters of data. The results are sorted according to the criteria selected in the Sorting and the Secondary Sorting options.

**Naming Convention for Carved Files**
For carved files, the naming convention is as follows: "Carved '**[type]**' file **[sector location in HEX]**. **[extension]**" e.g. "Carved 'jpg' file 0x0003FA22.jpg".

**Right-Click Menu**
Right-clicking a deleted file will open a context menu of options available on the selected file. Not all options may be available for carved files.




**View with Internal Viewer**
Opens the deleted file with OSForensics Viewer to perform a more thorough analysis

**Open (Default Program)**
Open the deleted file with the default program

**Open With**
Allows the user to select the program to open the deleted file

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**File Location Information**
Opens a graphical display of the location of the file clusters on the physical disk.

**Jump to disk offset...**
Opens the Raw Disk Viewer tab and jumps to the first cluster of the selected deleted file

**Add Results to Case**
Add the list of the deleted files results to the case as an HTML or CSV file

**Export Results to**
Export the list of the deleted files results and associated attributes to a TXT, CSV or HTML file

**Toggle Check**
Toggle the check state of the current item

**Check All**
Check all the items in the list.

**n item(s) checked**

**Add to Case**
Add the checked deleted file(s) or the list of selected item(s) to the case.

**Remove Deleted Files(s) from Case**
Remove the checked deleted file(s) from the case

**Calculate Hash of File(s)...**
Calculate the hash of the checked files.

**Look up in Hash Set**
Verify whether the checked deleted file(s) are contained in a hash set in the active database. See Hash Set Lookup.

**Export List to**
Export the checked deleted files and associated attributes to a TXT, CSV or HTML file

**Save Deleted Files(s) to disk**
Save the checked deleted files to disk. For clusters that have been allocated to another file, zeroes shall be written to the file

**Save Deleted Files(s) to disk (include allocated clusters)**
Save the checked deleted files to disk, including clusters that have been allocated to another file

## For best results

- For best results in recovering a deleted file, it is important that as little file activity occurs on the disk in question (like creating or changing files) as possible. Ideally no changes would be made. These changes could overwrite file information or file content.
- Consider taking an image of the disk in question as soon as possible
- Recovered files should be saved to a different drive as recovery to the same drive may overwrite some file information.
- Consider running OSForensics from a USB drive. This allows the use of the software without installation on the system hence reducing the likelihood of file system changes.

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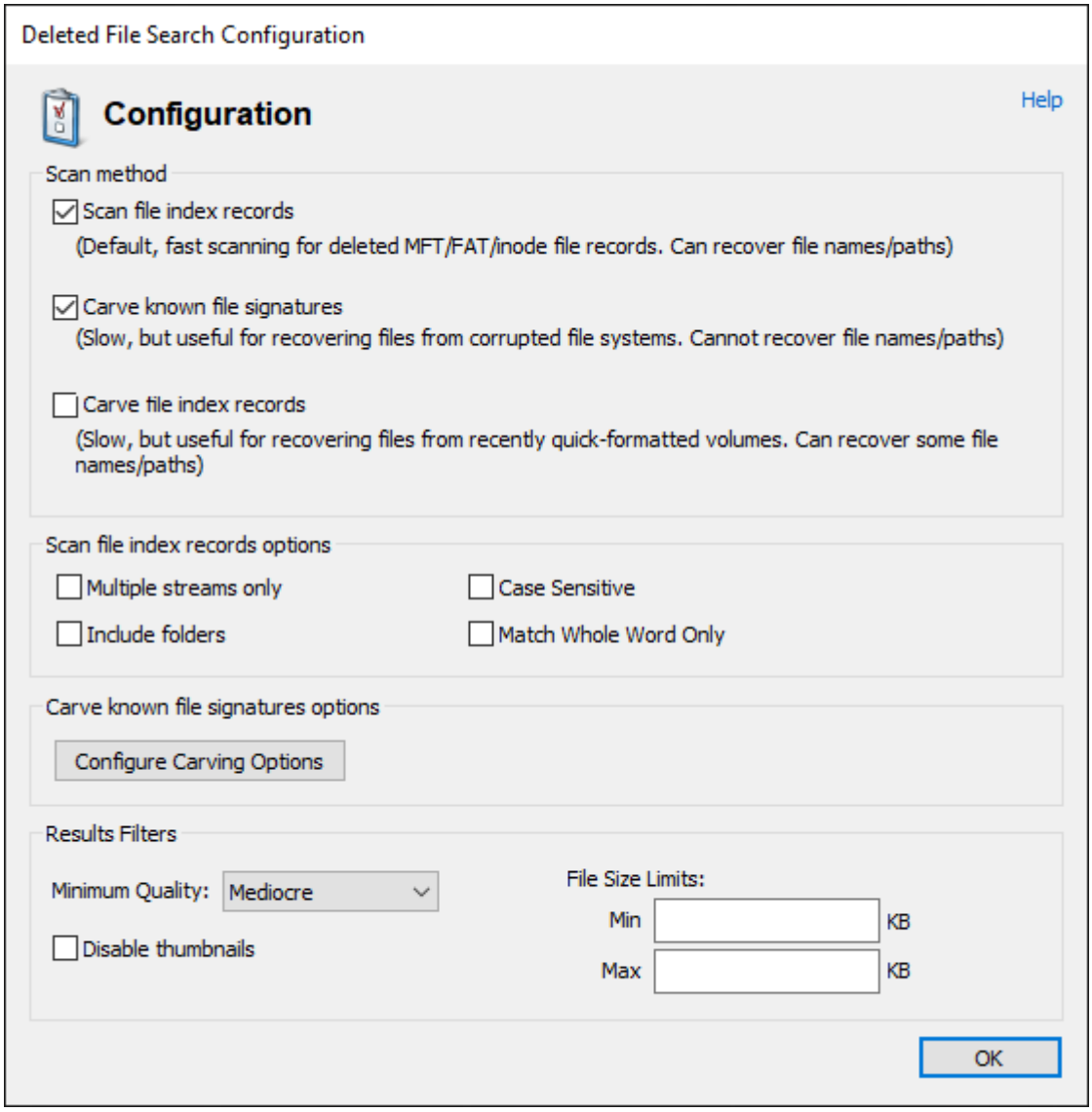
- Consider switching off power to your system after file deletion occurs, mounting the drive on a second system and then recovering files using the second system. This approach will minimize the likelihood of files being written to the disk you are recovering from.
- Disk image files and physical disks should be mounted in read only mode, where possible, to avoid any overwriting of data by the operating system or other applications.

### 5.6.1 Deleted Files Search Configuration

The Deleted Files Search Configuration Window allows users to configure the search settings for deleted files. This window can be accessed by clicking on the "Config..." button in the main Deleted Files Search window.




***Scan Method***

Specifies the method(s) that will be used to in the deleted file search. The default is for the deleted file search module to search in the Master File Table (MFT) and to perform file carving on the selected disk. If desired, scanning can be set to search the MFT or File Carve only. Note: When enabling File

Carving, instead of finding files from the master file tables, file carving looks at the raw physical disk data for file headers and attempts to recover files in this manner. This requires reading all data on the disk and as such is much slower than the standard method. Also it can only find a limited number of file types with known headers.

***Scan file index records options***
**Multiple streams only**
This option is disabled by default.

**Case Sensitive**
If checked, searches will be case sensitive. This option is disabled by default.

**Include Folders**
If checked, folder names will also be included in searches, not just filenames. This option is disabled by default.

**Match Whole Word Only**
If checked, results only include whether the search string is matched as a discreet word in the file name. In addition to spaces, the following characters are used as breaking characters around a word "_-.()[] ". For instance, searching for "Test" with this option enabled would return files like "_Test.txt", "A(Test).jpg", "This is a Test.docx" and "file.test". But it would not return "testing.txt", "testimony.pdf" or "contest.zip".

This option is disabled by default. This option has no effect on wildcard searches.

***Carve known file signatures options***
**Configure Carving Options**
Additional options for file carving. See File Carving Configuration below for available settings.

***Results Filters***
**Minimum Quality**
Determines the minimum quality level of the deleted file to include in the search results.

**Disable thumbnails**
Thumbnails are not automatically generated on the thumbnails tab. Thumbnail generation requires the found deleted files to be scanned and can slow down the recovery process. This option is enabled by default.

**File Size Limits**
Allows the user to specify file size limits for search results. The user may enter either a minimum, maximum, both or neither. The only restriction is that the maximum must be larger than the minimum.

## File Carving Configuration

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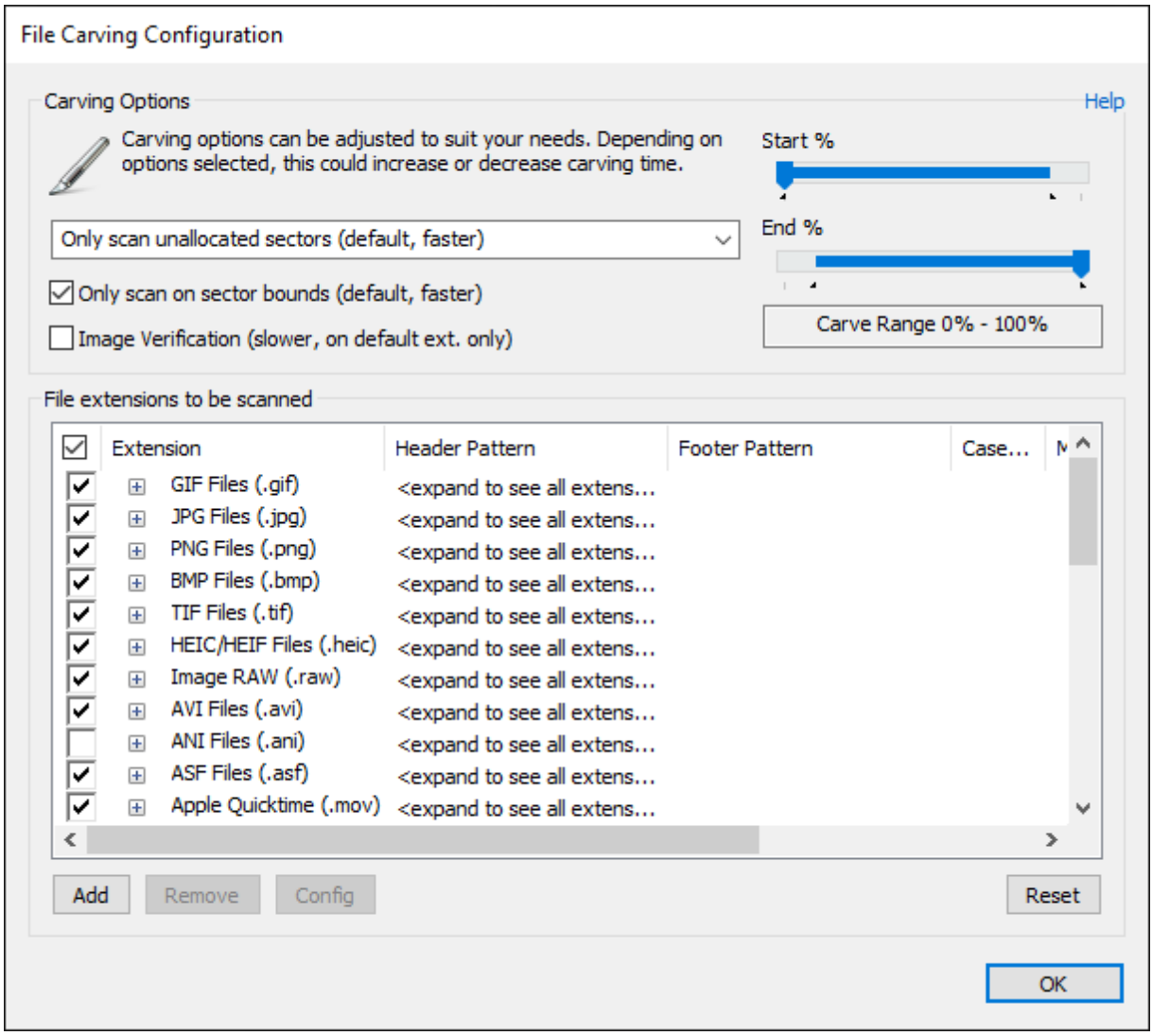


**Only scan unallocated sectors**
For FAT and NTFS files systems, OSForensics has the ability to only index the unallocated sectors on the drive. This will reveal files in unused portion of the disk. Selecting this option will force OSForensics to instead scan the whole drive including sectors that may be allocated for a non deleted file. When selecting a physical drive the entire contents of that drive will be searched, which may return files that are not actually deleted if there are working partitions on that drive. When selecting a single partition only unallocated space on that partition will be searched.

**Only scan on sector bounds**
With this option enabled, only the beginning bytes of a sector will be used to look for a **header pattern** match. By default this option is enabled as files are typically only saved to disk on free sectors (the files contents are stored beginning at the start of the sector). By disabling this option, OSForensics will try to look for **header patterns** anywhere within the whole sector. This can be useful for carving for files (e.g. images) that may be embedded within another file (e.g. PDF document). However, this option should be used with caution as it can greater increase carving time and will likely return many false matches.

**Image Verification**
Applies extra level of checking to carved image files by trying to open the whole file with an image parser. Slows down the file carving process but provides better feedback on the file quality. If the

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image parser is successful in opening the image, the overall score is boosted by 25%. Similarly, if the image parser files to open the image, the overall score is decreased by 25%.

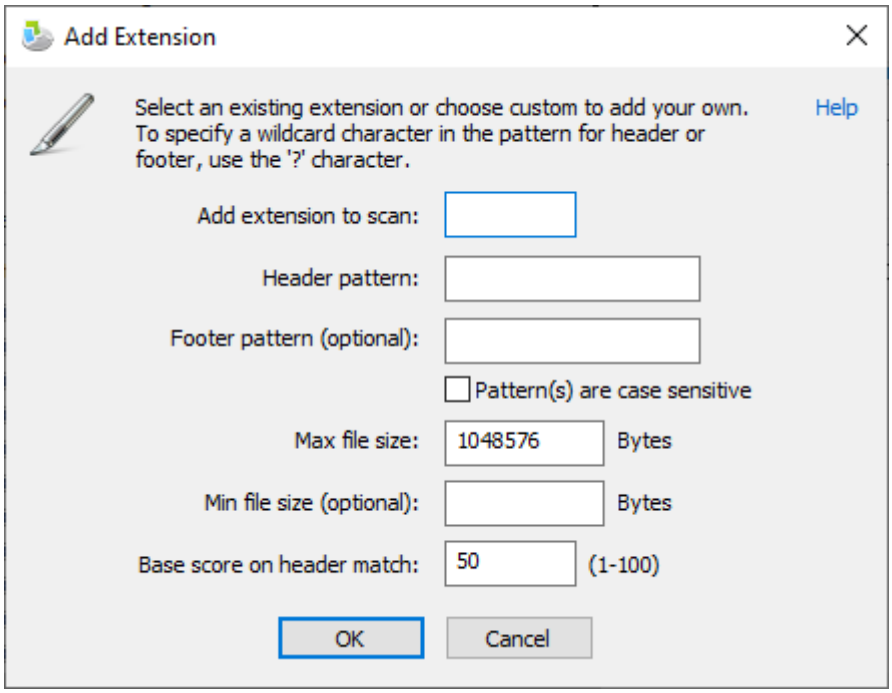
**Range Selection**
Allows the selection of carving range. Useful to look at a certain portion of the drive.

**File extensions to be scanned**
Currently default supported built-in file types are: gif, png, bmp, tif, asf, wmv, wma, mov, mpg, mp4, swf, flv, ole, doc, xls, ppt, msi, mst, msp, gra, zip, docx, xlsx, pptx, htm, pdf, wav, mp3, rar, eml and rtf.

The pre-defined file types have coded file recovery functions that will do a superior job than a straight header/footer match.

Additional file types can be added or currently enabled file types can be removed. The default file types, identified by light grey text, in the list can be removed but cannot have their definitions edited.

## Add Extension




OSForensics will carve user defined file types, but will only look for header pattern and/or footer pattern. When a footer pattern is not specified. OSForensics will return default to the size of the maximum file size defined. When "File Carving" is enabled, OSForensics uses built-in values for maximum file size limits. The file size limit is dependent on the type of file, however, the overall file size limit for all files during carving is limited to 50MB.

### 5.6.2 Deleted Files Search Results View

The user may view the deleted file search results in one of four views.

## File Details View

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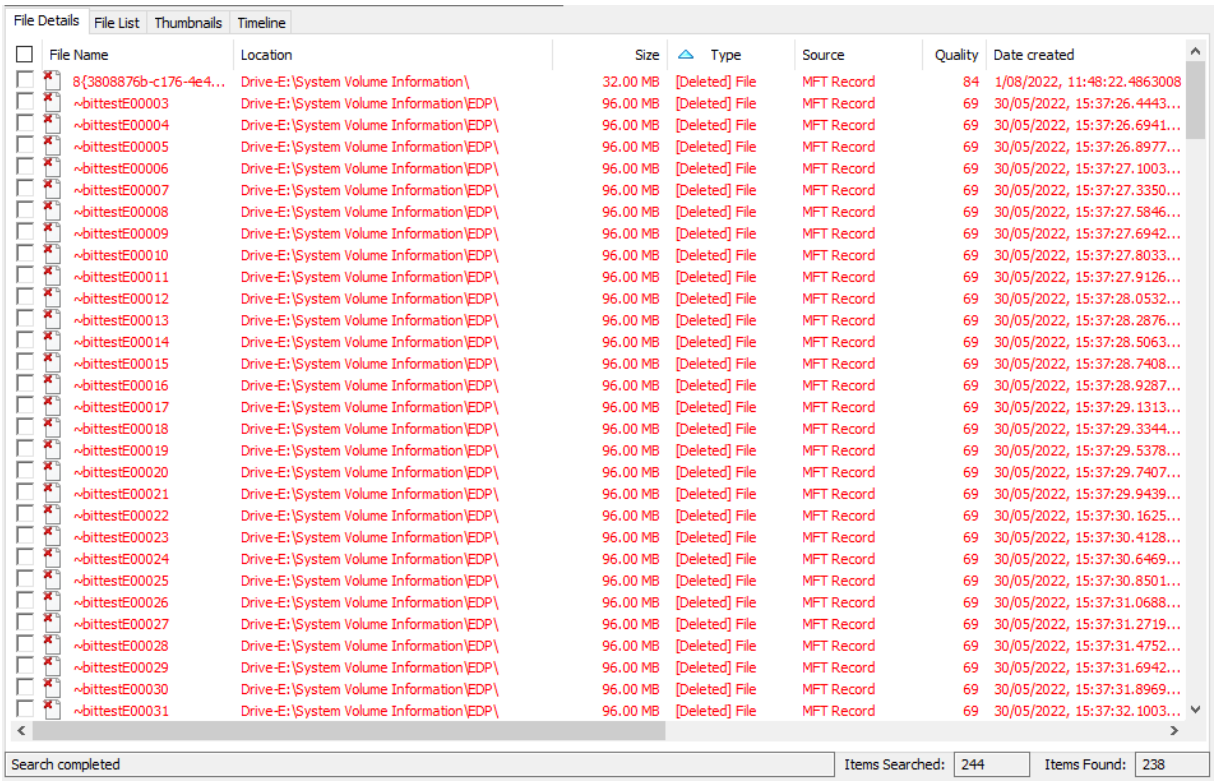
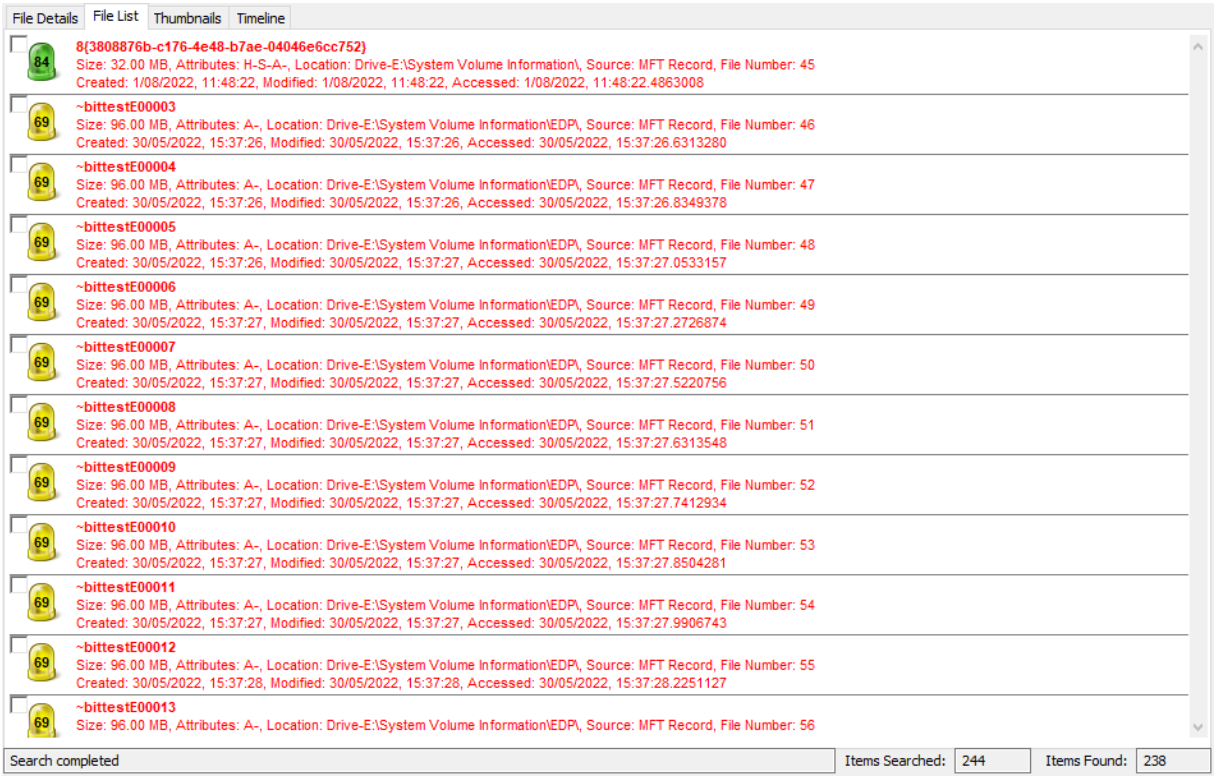


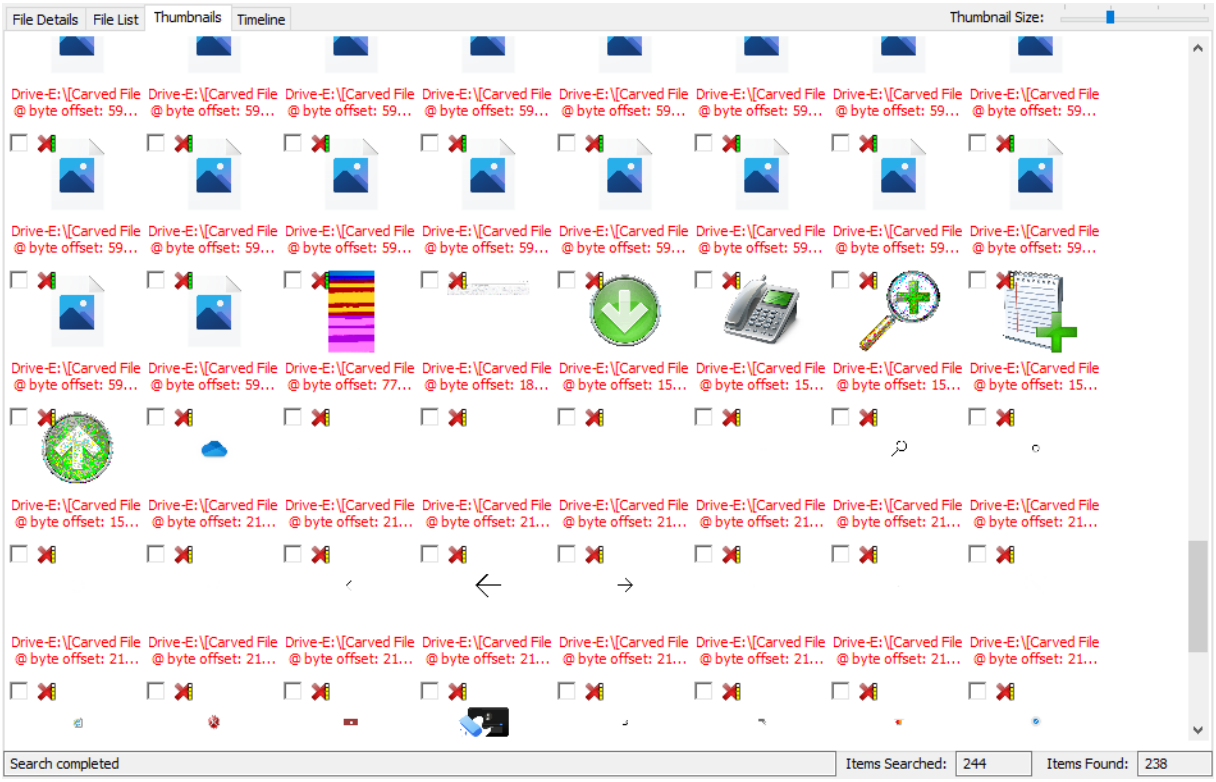

The File Details View displays the search result in a table format, listing the file names along with relevant attributes and metadata. The results are sorted according to the criteria selected in the Sorting options.

## Deleted File List View




The Deleted File List View displays the search result as a list of file names, along with the corresponding metadata and icon. The results are sorted according to the criteria selected in the Sorting options.

## Thumbnails View




The Thumbnails View displays the search results as a list of thumbnails as well as with its file path. This view is useful when searching for media files, allowing the user to quickly browse through the thumbnail images. The size of the thumbnails can be adjusted using the Thumbnail Size slider bar.

## Timeline View

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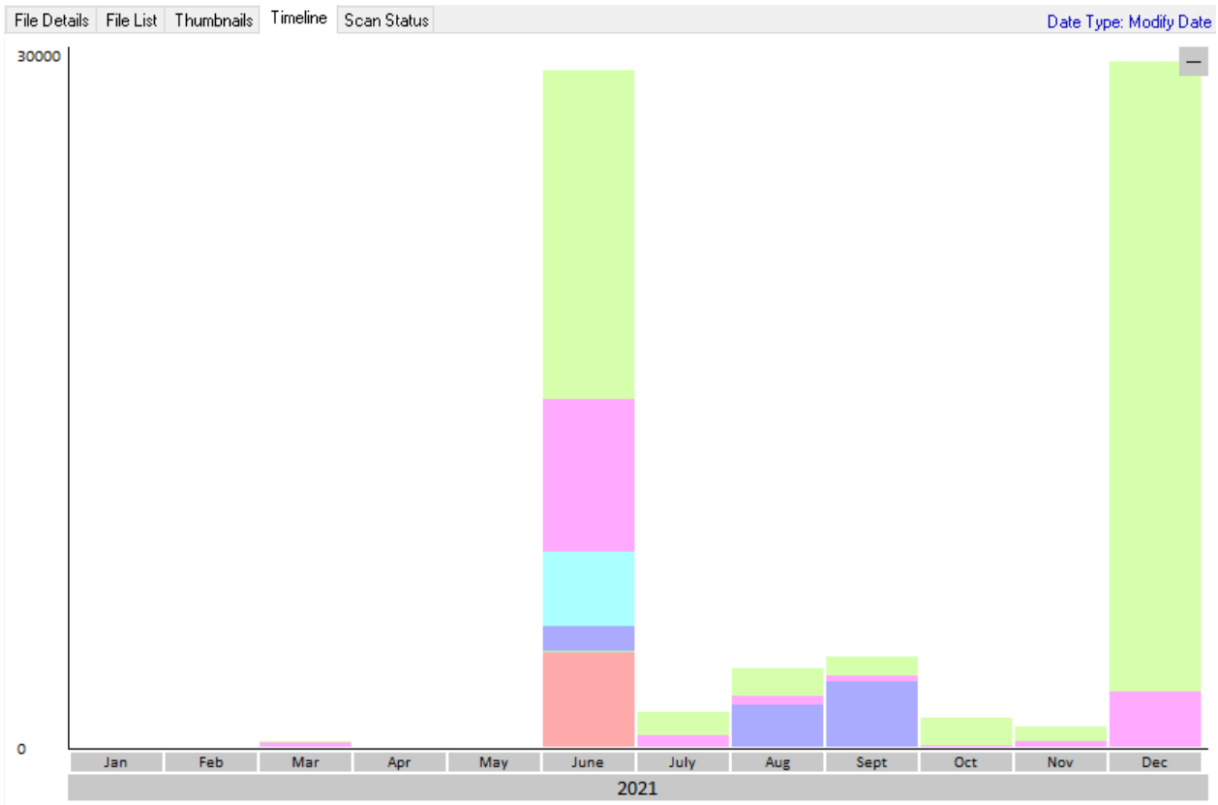
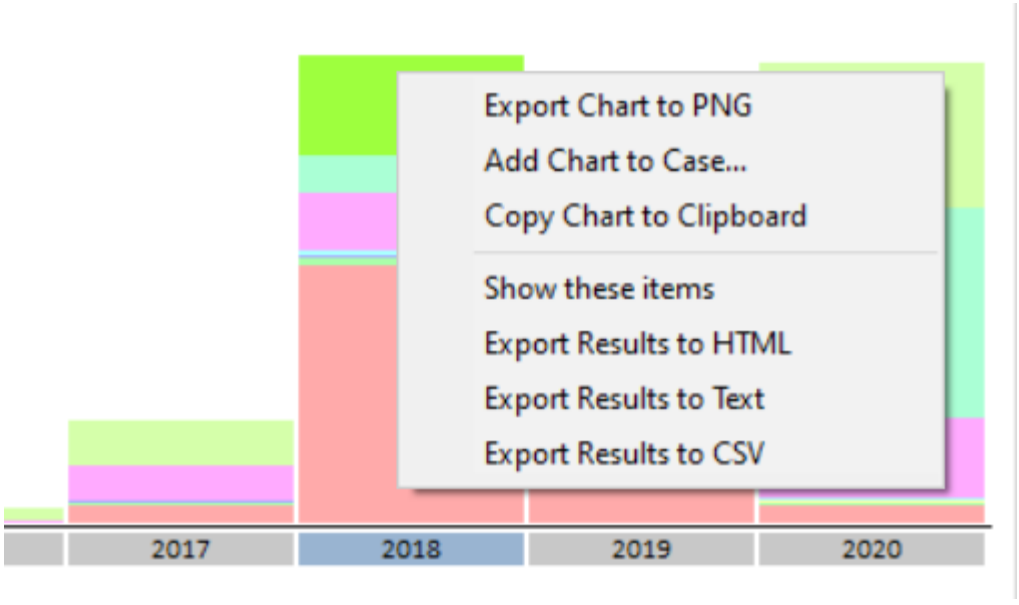



The Timeline View displays an interactive bar graph providing the user with a visual view of the distribution of files with respect to the date of the files. This view is useful for identifying date ranges where significant deleted file activity has occurred. The granularity of the scale can be adjusted by clicking on the bar graphs to zoom in or the '-' button on the top-right corner to zoom out. Right-clicking a bar section brings up the following menu:




**Show these files**
Filter the deleted files to show only those that belong to the selected time bar

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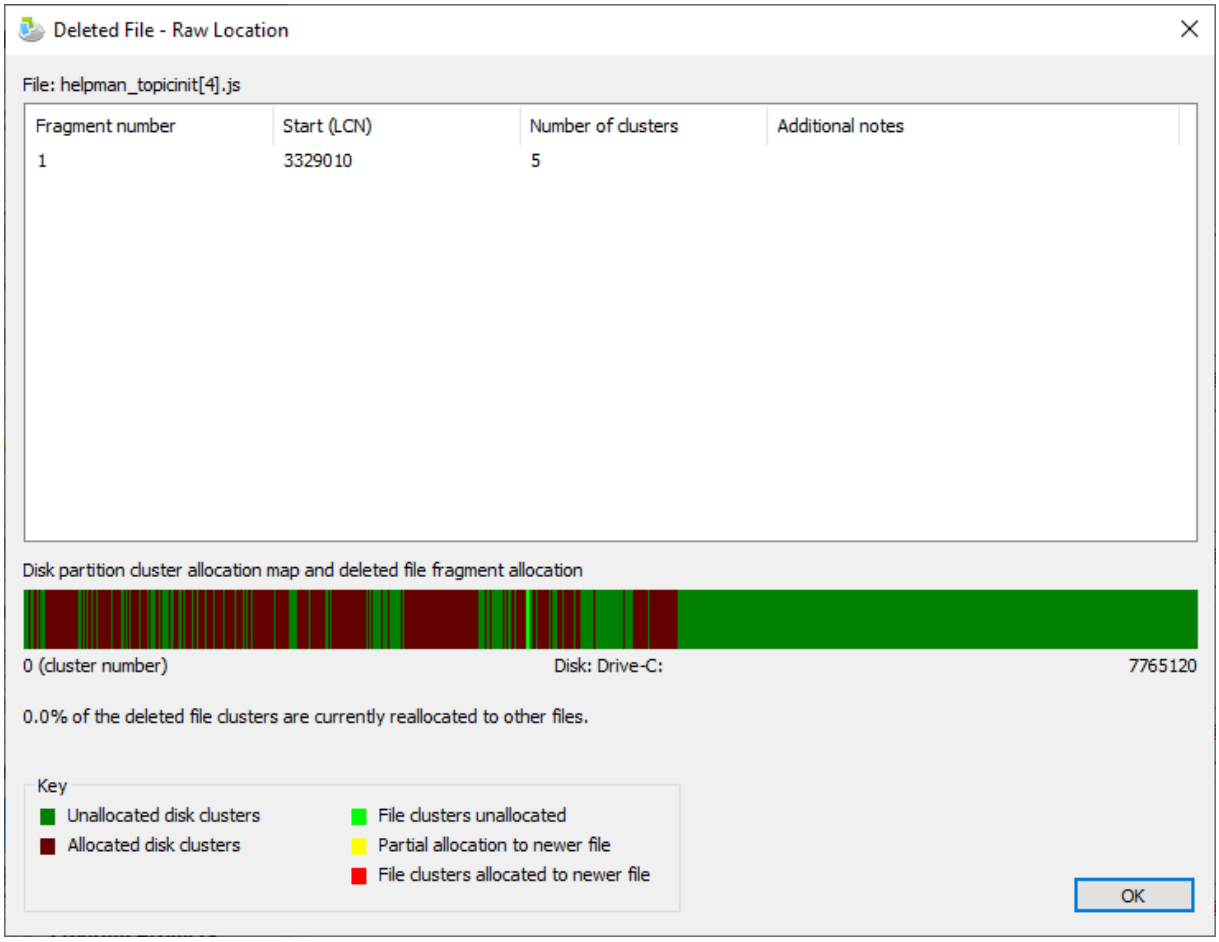
**Export to HTML**
Export the deleted files contained in the highlighted bar to HTML

**Export to Text**
Export the deleted files contained in the highlighted bar to text

**Export to CSV**
Export the deleted files contained in the highlighted bar to CSV

### 5.6.3 Deleted File Cluster View

The Deleted File Cluster View window provides a graphical view of the allocation of the deleted file clusters on the physical disk. This window can be accessed by right-clicking a NTFS or FAT filesystem deleted file in the Deleted Files Search and selecting File Location Information.




The table displays the fragmentation information of the deleted file. For smaller files, the deleted file may be resident in the MFT (NTFS only).

The map provides a graphical representation of the location of the fragments with respect to the physical disk it resides on.

For files that reside on FAT filesystems, only the first cluster fragment is shown and the number of clusters field will be the count of free clusters following the start cluster. If the file is fragmented, then

the number of clusters may not match the filesize. FAT file system uses a directory entry for each file and folder allocated on the drive. In the directory entry in FAT it stores the starting cluster only. To access the file, the OS looks in directory finds file and notes the starting cluster. Then it proceeds to the FAT (file allocation table) cluster that corresponds to the starting cluster. The starting cluster entry contains the cluster number of the next cluster. The next cluster entry points to the next cluster and so on until you come to an end of file marker. When you delete a file or folder. It locates the directory entry the file resides in and mark it as deleted and it deletes the FAT chain. That is why you can typically only recover contiguous files in FAT system once a file is deleted.

### 5.6.4 Deleted Files Techincal Details

## Background

A physical disk has a partition table that describes the partitions on the disk, such as where the partitions are located on the disk and the format of the partitions (e.g. NTFS, FAT32, FAT16).

An NTFS (NT File System) partition contains a boot sector, which contains information like the partition sector size, cluster size and boot code. An important concept for NTFS is the Master File Table (MFT), which is like an index for all files on the system. The Master File Table contains information like the Filename, size, attributes, and location of file data fragments on the disk. Very small files can be contained in the Master File Table record (called resident). When a file is deleted from an NTFS volume, the Master File Table entry for the file is marked as deleted. The file information such as name, size and location on the disk is not deleted and the data is not deleted. After deleting a file, the file system is free to re-allocate the MFT record and the data clusters to another file.

FAT (File Allocation Table) is a generally used on external drives, like USB drives. FAT32 is newer than FAT16, and allows for larger files and disks. A FAT partition contains a boot sector, a FAT and a data area. The boot sector contains information like the partition sector size, cluster size and boot code. The FAT contains a map of cluster allocation for the data area; with file data described as a set of linked clusters. The Data area contains both information about files and the actual file data. When a file is deleted from a FAT volume, all clusters in the FAT table related to the file are set to unallocated and the file information in the data area is marked as deleted (by changing the first character of the filename). The file data is not deleted. After a file is deleted we potentially have the first cluster the file used, but do not know which subsequent clusters were used, as this (chain link) information was removed from the FAT. As such, to recover a file, assumptions based on file system behavior and current cluster allocation, are needed to estimate the most likely clusters that were in the file. There are some cases were this will not work well for any FAT recovery tool. After deleting a file, the file system is free to re-allocate the FAT cluster map and the data area used for file information and file data.

## Recovering files deleted from the recycling bin

Moving a file to the recycling bin in NTFS moves the file to the hidden system directory $RECYCLE.BIN and renames the file (e.g. file1.txt to $RH7IJX4.txt). It also creates a new file (e.g. $IH7IJX4.txt). This file contains recycle bin file restore data, such as the directory and the original filename (e.g. C:\dir1\file1.txt).

When you delete the file from the recycling bin (such as emptying the recycling bin), both files are deleted by marking the MFT records as not in use. Both of these files are potentially recoverable, but with the new filenames. OS Forensics checks whether both files are available, and if they are, then the

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original filename is retrieved from the recycling bin metadata file and is shown as well as the recycling bin filename.

On searching for deleted files, when the original filename can be recovered from the recycling bin metadata file content, the search string specified is matched with the original deleted filename (e.g. file1.txt). When the recycling bin Meta data file content is not recoverable, a search for the recycle bin filename is required (e.g. on *.txt to match “$RH7IJX4.txt”).

Examples:

(1) Where the information about the deleted files and metadata can be recovered, a search for “file1” will return the result “file1.txt (Recycle bin name: $RH7IJX4.txt)”. If the recycling bin metadata file content cannot be recovered, then the original file will only be known as “$RH7IJX4.txt”, and no match will occur.

(2) Where the information about the deleted files and metadata can be recovered, a search for *.txt would return the original filename “file1.txt (Recycle bin name: $RH7IJX4.txt)” and the recycling bin metadata file “$IH7IJX4.txt”. If the recycling bin metadata file content cannot be recovered, then the recycling bin name “$RH7IJX4.txt” and metadata file “$IH7IJX4.txt” will be returned. Further, if the recycling bin metadata file information cannot be recovered, then the recycling bin filename “$RH7IJX4.txt” will be returned. If the file content is recoverable, then the original content for file1.txt will be in the “$RH7IJX4.txt”.

## 5.7 Drive Preparation

This module provides three different features. Firstly it can test a drive for reliability, potentially identifying any faulty drives before they are put into active use in an investigation. Secondly it can set all bytes of a drive to a specified byte pattern (and verify the byte pattern has been written to the entire drive), making sure there is no chance of data contamination between investigations. Lastly, it can format the drive to either NTFS or FAT32 file system to be ready to be used for investigation.

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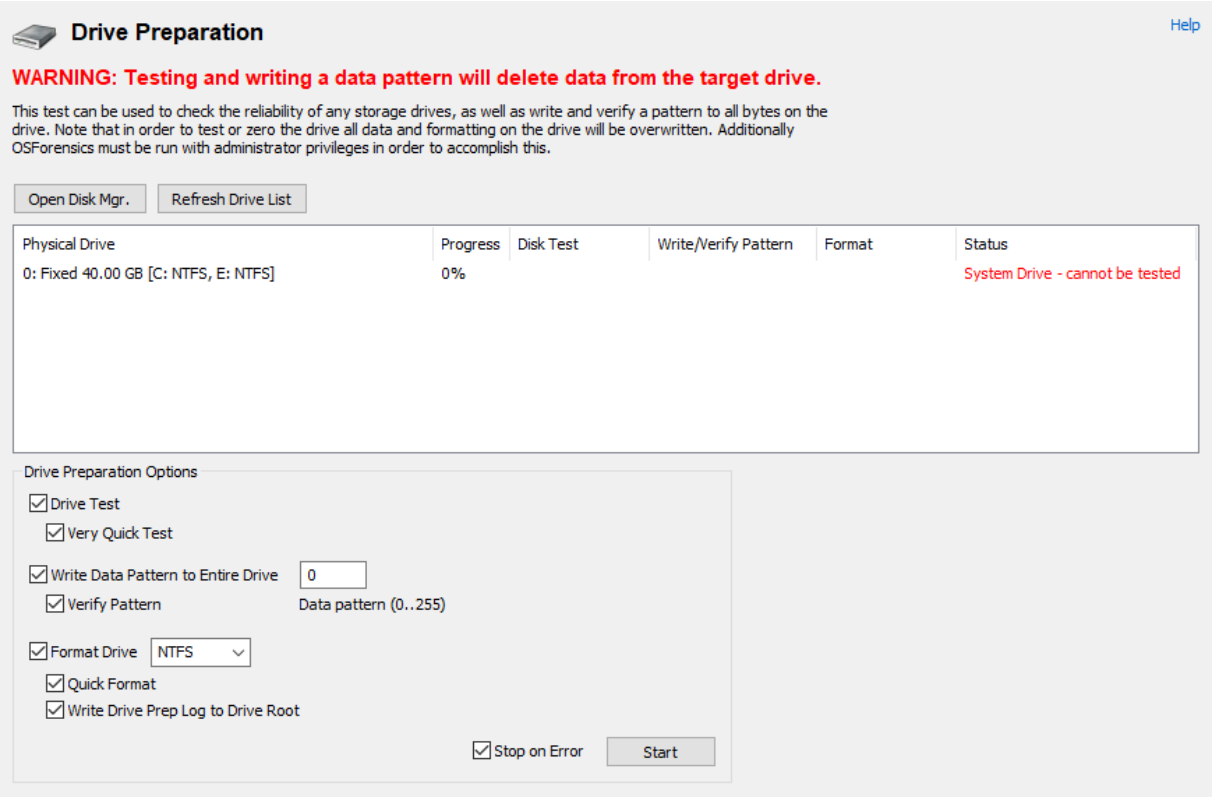


# Drive List

The Drive list shows 6 columns:

- Drive: Shows the disk volume and/or physical drive number. May also show the volume name, type of disk, size and file system type.
- Progress: Progress of the test, zeroing or verification, or file system format as a percentage.
- Disk Test: Shows In Progress when testing or testing pass or failure upon completion.
- Write/Verify Pattern: Shows In Progress when writing or verifying or pass or failure upon completion.
- Format: Shows In Progress when formatting or pass or failure upon completion.
- Status: A brief summary of the current activity or the result.

Multiple disks (up to 100 disks) can be acted on at once by selecting the multiple rows in the drive list. An action may be stopped at any time with the “Stop” button.

If additional drives have been added to the system since OSForensics has been started, you can refresh the list of drives that can be tested with the “Refresh drive list” button.

# Drive Preparation Options

## Drive Test

This test does not test the entire drive, as in most cases this would take very many hours. Rather, to provide the fastest possible test, while providing the greatest test coverage of the drive, the test writes and reads test data to the drive directly and not via the File System e.g. NTFS. The test will test the start of the drive, the end of the drive and random samples in between. The random samples stage of

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the test will continue until about 10% of the disk is tested. As such, the drive test WILL DELETE the file system information (e.g. NTFS) and data on the drive. Administrator privileges are required for this test.

Very quick drive test: When selected, the testing is kept to about 3 minutes.

The drives that can be tested are shown in the physical drive list. The only drives allowed to be tested are fixed and removable drives. The system drive (ie. "C:") cannot be tested.

### Write a data pattern to the entire drive

This action makes sets every byte on the hard drive to the specified value (default zero). Effectively blanking out a disk and removing any possibility of data cross-contamination when using the drive in a new investigation. After the write pattern process is complete the "Verify pattern" action can ensure the process was successful by reading back all data from the disk and checking each byte value is the specified byte value,

As this function acts on the entirety of a drive it may take some time, depending on the size of the drive.

### Format Drive

This action will setup the partition and format the drive. Any previous partitions or file systems that may be present will be removed and replaced with a single volume containing either NTFS or FAT32 file system. FAT32 is only allowed on drives no larger than 2 TB in total size. If "Quick Format" is unselected, then the free disk space for the volume will be written with zeros.

The "Write Drive Prep Log to Drive Root" option will write a short text log of the test and options chosen during preparation of the drive. The Drive log can only be written if the formatting was successful and the volume is accessible.

### Open Disk Manager

After the drive is tested or a data pattern written and verified, the drive will need to be formatted. The Open disk manager option opens Windows disk manager to allow the drive(s) to be partitioned and formatted as required.

### Start/Stop

Start will start the selected operations on the drives selected. The order of the operations if selected is "Drive Test"->"Write Pattern"->"Verify Pattern"->"Format"->"Write Log". You can select one more operations to start continuous one click testing. When "Stop on Error" is enabled. Individual drives will halt their preparation and will not move to their next step if an error occurs in the previous step. Other drives will continue as normal until completion.

Stop will signal a stops to all ongoing operations (e.g. drive test, writing/verifying a data pattern or formatting).

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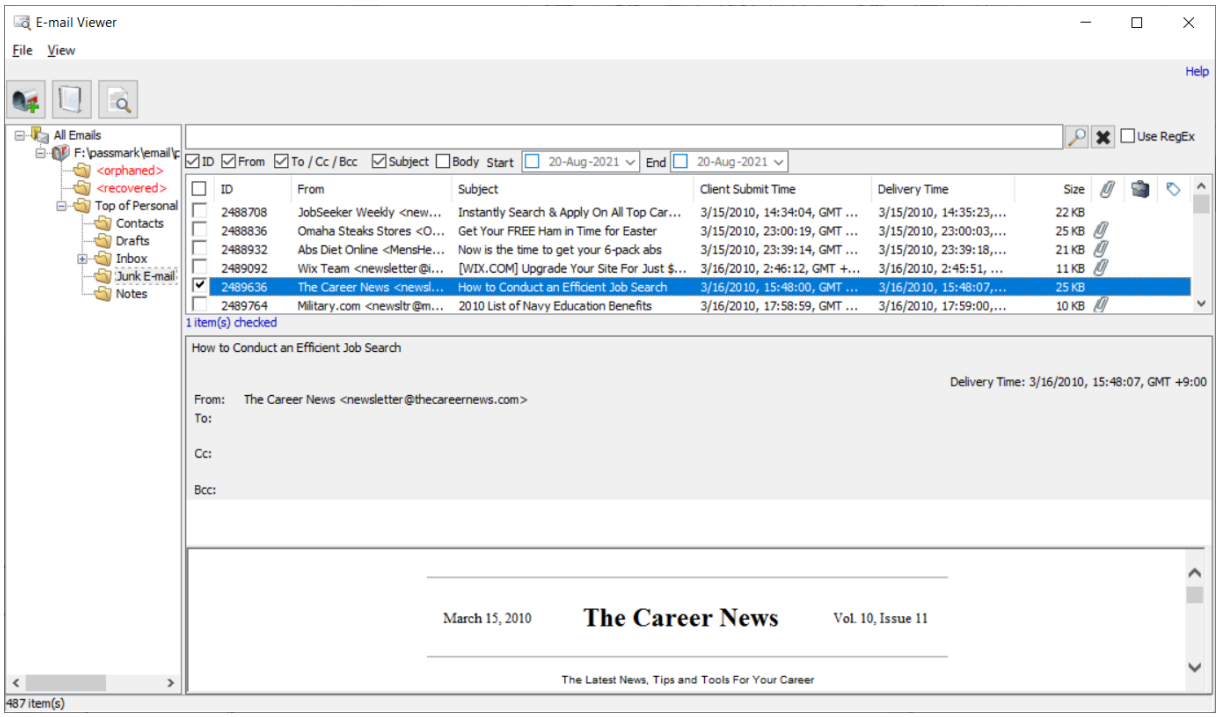
## 5.8 Email Viewer

The Email Viewer provides a simple yet powerful interface for browsing and analyzing e-mail messages across multiple e-mail files.




**OSForensics Email Viewer**

The left pane provides a hierarchical view of all devices added to the case. Clicking on a node shall load its contents into the right pane.

## Understanding the Email Viewer

The table below summarizes the main components of the Email Viewer

| Component | Description |
|---|---|
| E-mail Hierarchical View | Tree organization of all e-mail files currently being browsed. Selecting a folder will display the list of e-mail it contains. |
| E-mail List | List view of the e-mail contained in the current folder. Selecting an e-mail will display the e-mail contents in the Preview Pane. |
| E-mail Preview Pane | Displays the e-mail contents of the currently selected e-mail |
| E-mail Filter | Filters the list of e-mail to those that match the specified criteria |

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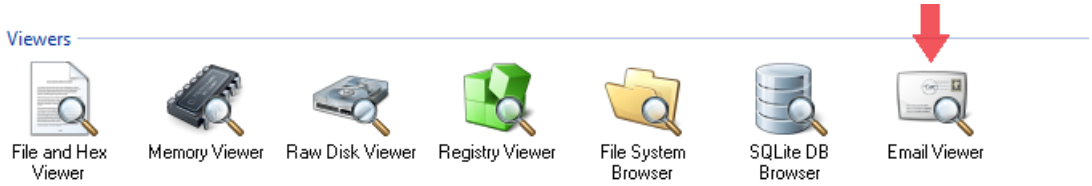
# Opening the Email Viewer

The Email Viewer is accessible via the "Email Viewer" icon in the "Viewers" group under the Start tab. Once opened, the user is prompted to select an e-mail file to view.




# Usage

## Search

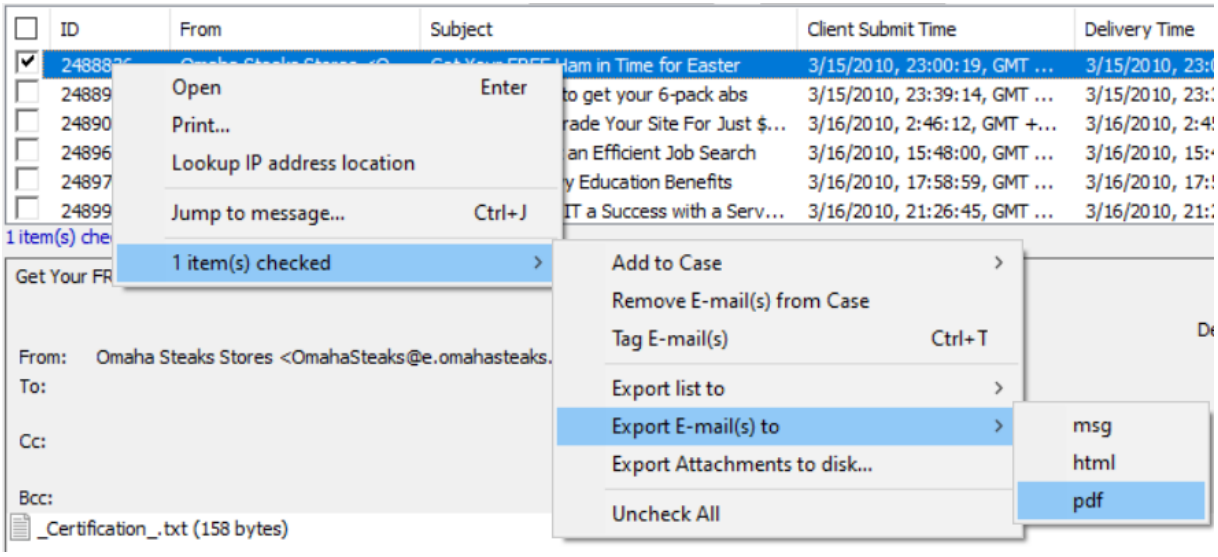
To search for e-mail messages that contain a particular text, enter a search expression in the search bar, specify any additional search parameters and click 'Search'. To use Regular Expressions, check the 'Use RegEx' checkbox. Additionally, e-mail messages can be filtered by when they were sent/received.

To remove the search results, click 'Clear Search'.

## Right-click Menu

The right-click menu integrates the E-mail Viewer with OSForensics' analysis tools.

### *E-mail List Menu*




**Open**
Opens the message in a separate window.

**Jump to message**

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Jump to a message specified by a message ID.

**Print...**
Print the e-mail

**Lookup IP address location**
Parse the e-mail header for IP addresses and plot the geolocation in the Map Viewer.

**n Item(s) checked**

**Add to Case**
Add the checked e-mail(s) or list of checked e-mail(s) to the case

**Remove File(s) from Case**
Remove the checked e-mail(s) from the case

**Tag E-mail(s)**
Tag the selected e-mail(s) for future reference. *Keyboard shortcut: Ctrl+T*

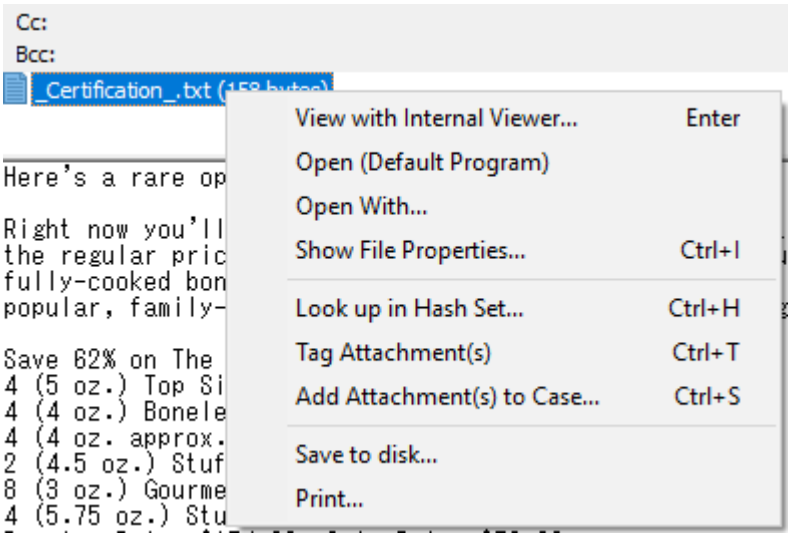
**Export list to**
Export the list of checked e-mail(s) to a TXT, CSV or HTML file

**Export E-mail(s) to**
Exports the checked e-mail(s) to HTML, MSG or PDF file(s)

**Export Attachments to disk**
Exports the attachments of all checked e-mail(s) to a location on disk

**Uncheck All**
Uncheck all checked e-mail(s)

***Attachment Menu***




**View with Interval Viewer...**

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Opens the file with OSForensics Viewer to perform a more thorough analysis. *Keyboard shortcut: Enter*

**Open (Default Program)**
Opens the file with the default program. *Keyboard shortcut: Shift+Enter*

**Open With...**
Allows the user to select the program to open the file

**Show File Properties...**
Opens the file with OSForensics Viewer in File Info mode. *Keyboard shortcut: Ctrl+I*

**Look up in Hash Set...**
Verify whether the selected attachments are in a hash set in the active database. See Hash Set Lookup. *Keyboard shortcut: Ctrl+H*

**Tag Attachment(s)**
Tag attachment(s) for future reference. *Keyboard shortcut: Ctrl+T*

**Add Attachment(s) to Case...**
Opens a dialog prompting the user to enter details for the selected attachment(s) to add to the case. *Keyboard Shortcut: Ctrl+S*

**Save to disk...**
Saves the selected attachment(s) to a location on disk

**Print...**
Prints the attachment (if applicable)

## Deleted E-mails

The Email Viewer supports recovering deleted and orphaned e-mails within PST files. To scan for deleted/orphaned e-mails, click on either the "<orphaned>" or "<recovered>" folders after loading the PST file.

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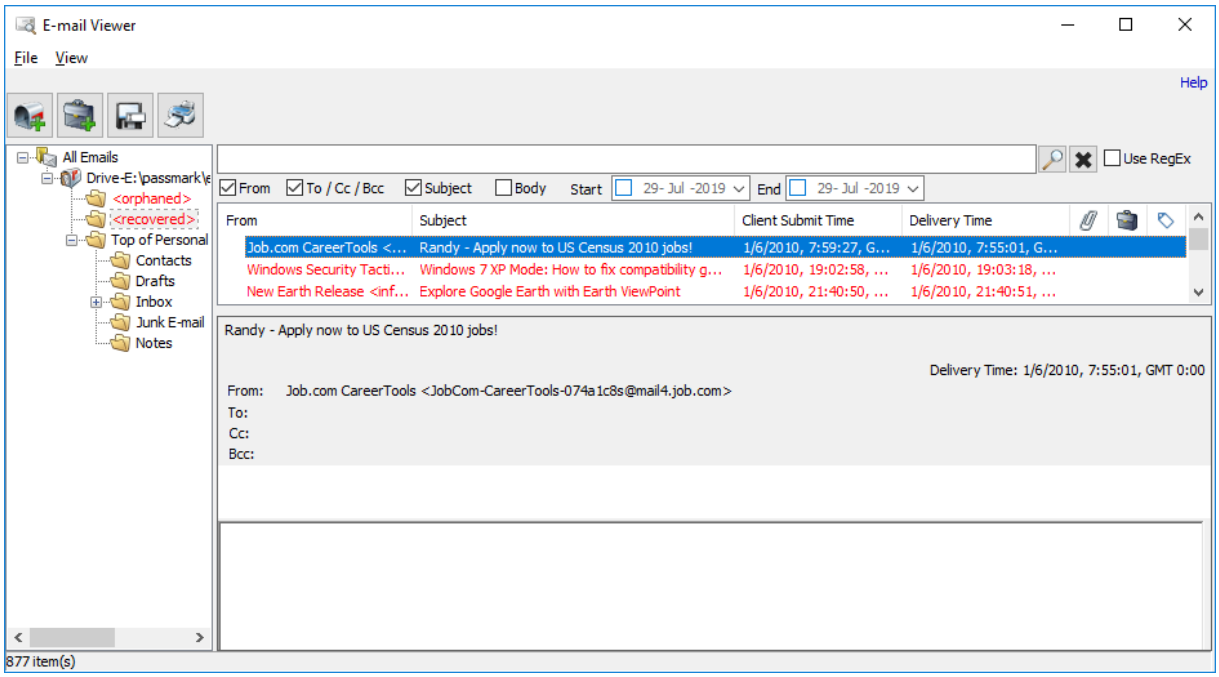
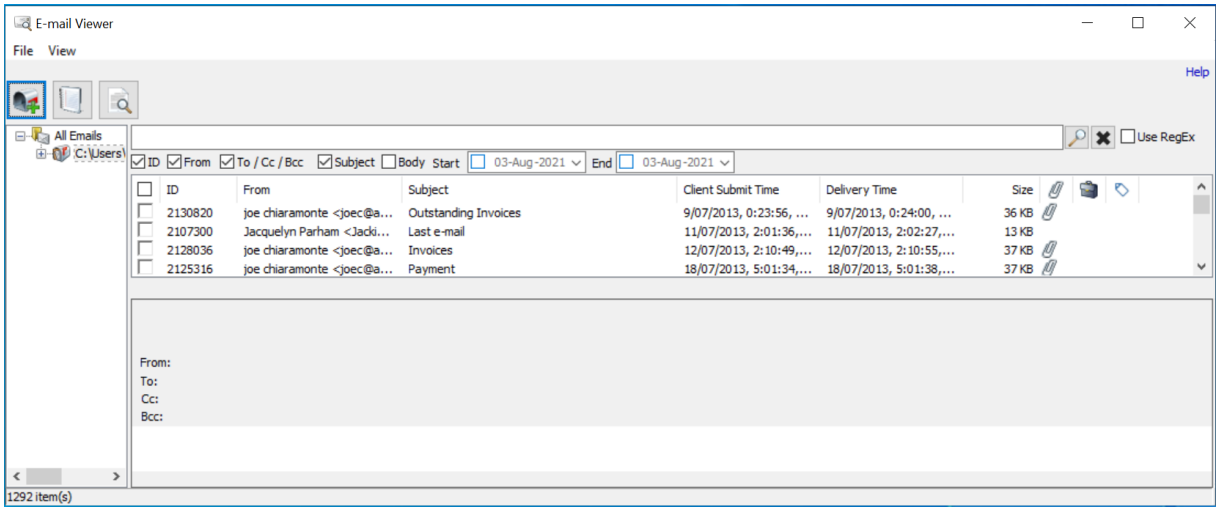



The "<orphaned>" folder contains all e-mail items that do not have a parent folder, possibly due to a corrupted file. The "<recovered>" folder contains all e-mails that have been deleted but the data still remains in the unallocated space of the PST file.

## Email Overview



**Full Mailbox Overview**

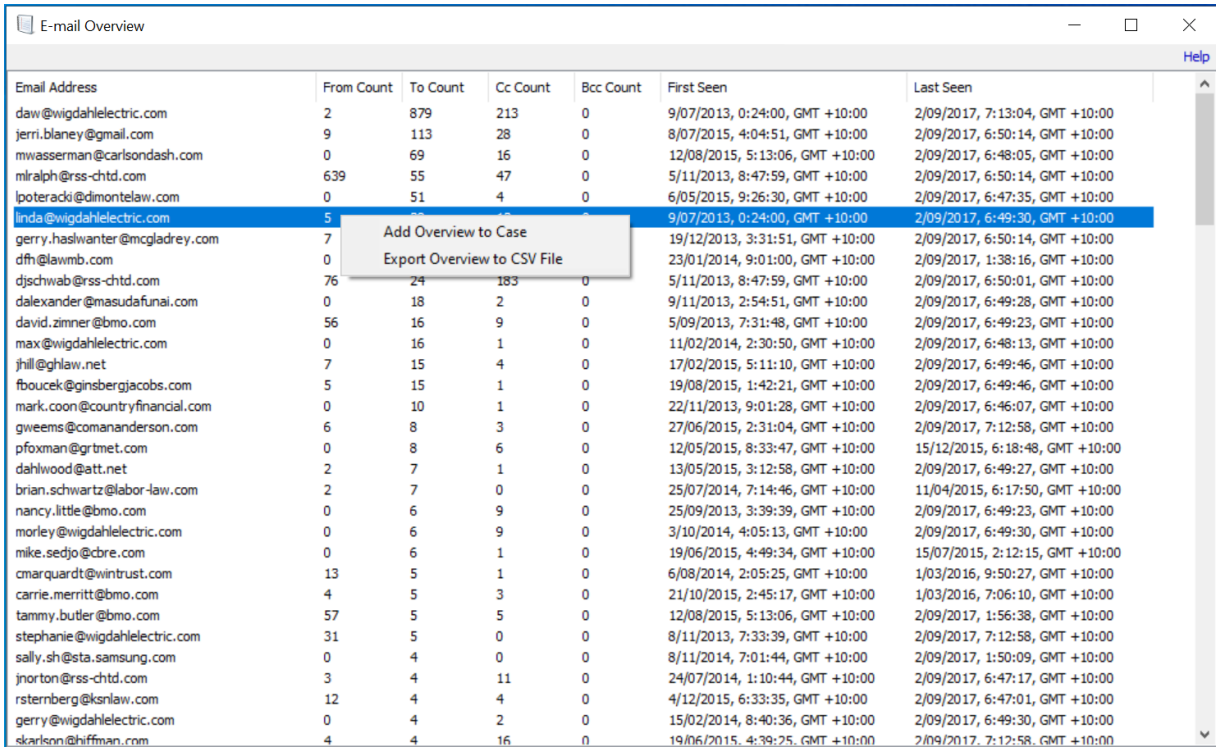
From the main window click this button to generate a summary of all emails currently opened.

If multiple mailboxes are opened they will be combined into one summary.

The summary consists of a table showing the counts of how many times every address has appeared in the corresponding header field, as well as the time of the first and last occurrence of an address.

The table can be sorted by any column by clicking on the columns heading.

You can add the table to the case or export it to a CSV file via the right click menu.




| Email Address | From Count | To Count | Cc Count | Bcc Count | First Seen | Last Seen |
|---|---|---|---|---|---|---|
| daw@wigdahlelectric.com | 2 | 879 | 213 | 0 | 9/07/2013, 0:24:00, GMT +10:00 | 2/09/2017, 7:13:04, GMT +10:00 |
| jerri.blaney@gmail.com | 9 | 113 | 28 | 0 | 8/07/2015, 4:04:51, GMT +10:00 | 2/09/2017, 6:50:14, GMT +10:00 |
| mwasserman@carlsondash.com | 0 | 69 | 16 | 0 | 12/08/2015, 5:13:06, GMT +10:00 | 2/09/2017, 6:48:05, GMT +10:00 |
| mlralph@rss-chtd.com | 639 | 55 | 47 | 0 | 5/11/2013, 8:47:59, GMT +10:00 | 2/09/2017, 6:50:14, GMT +10:00 |
| lpoteracki@dimontelaw.com | 0 | 51 | 4 | 0 | 6/05/2015, 9:26:30, GMT +10:00 | 2/09/2017, 6:47:35, GMT +10:00 |
| linda@wigdahlelectric.com | 5 | | | | 9/07/2013, 0:24:00, GMT +10:00 | 2/09/2017, 6:49:30, GMT +10:00 |
| gerry.haslwanter@mcgladrey.com | 7 | | | | 19/12/2013, 3:31:51, GMT +10:00 | 2/09/2017, 6:50:14, GMT +10:00 |
| dfh@lawmb.com | 0 | | | | 23/01/2014, 9:01:00, GMT +10:00 | 2/09/2017, 1:38:16, GMT +10:00 |
| djschwab@rss-chtd.com | 76 | 24 | 183 | 0 | 5/11/2013, 8:47:59, GMT +10:00 | 2/09/2017, 6:50:01, GMT +10:00 |
| dalexander@masudafunai.com | 0 | 18 | 2 | 0 | 9/11/2013, 2:54:51, GMT +10:00 | 2/09/2017, 6:49:28, GMT +10:00 |
| david.zimner@bmo.com | 56 | 16 | 9 | 0 | 5/09/2013, 7:31:48, GMT +10:00 | 2/09/2017, 6:49:23, GMT +10:00 |
| max@wigdahlelectric.com | 0 | 16 | 1 | 0 | 11/02/2014, 2:30:50, GMT +10:00 | 2/09/2017, 6:48:13, GMT +10:00 |
| jhill@ghlaw.net | 7 | 15 | 4 | 0 | 17/02/2015, 5:11:10, GMT +10:00 | 2/09/2017, 6:49:46, GMT +10:00 |
| fboucek@ginsbergjacobs.com | 5 | 15 | 1 | 0 | 19/08/2015, 1:42:21, GMT +10:00 | 2/09/2017, 6:49:46, GMT +10:00 |
| mark.coon@countryfinancial.com | 0 | 10 | 1 | 0 | 22/11/2013, 9:01:28, GMT +10:00 | 2/09/2017, 6:46:07, GMT +10:00 |
| gweems@comananderson.com | 6 | 8 | 3 | 0 | 27/06/2015, 2:31:04, GMT +10:00 | 2/09/2017, 7:12:58, GMT +10:00 |
| pfoxman@grtmet.com | 0 | 8 | 6 | 0 | 12/05/2015, 8:33:47, GMT +10:00 | 15/12/2015, 6:18:48, GMT +10:00 |
| dahlwood@att.net | 2 | 7 | 1 | 0 | 13/05/2015, 3:12:58, GMT +10:00 | 2/09/2017, 6:49:27, GMT +10:00 |
| brian.schwartz@labor-law.com | 2 | 7 | 0 | 0 | 25/07/2014, 7:14:46, GMT +10:00 | 11/04/2015, 6:17:50, GMT +10:00 |
| nancy.little@bmo.com | 0 | 6 | 9 | 0 | 25/09/2013, 3:39:39, GMT +10:00 | 2/09/2017, 6:49:23, GMT +10:00 |
| morley@wigdahlelectric.com | 0 | 6 | 9 | 0 | 3/10/2014, 4:05:13, GMT +10:00 | 2/09/2017, 6:49:30, GMT +10:00 |
| mike.sedjo@cbre.com | 0 | 6 | 1 | 0 | 19/06/2015, 4:49:34, GMT +10:00 | 15/07/2015, 2:12:15, GMT +10:00 |
| cmarquardt@wintrust.com | 13 | 5 | 1 | 0 | 6/08/2014, 2:05:25, GMT +10:00 | 1/03/2016, 9:50:27, GMT +10:00 |
| carrie.merritt@bmo.com | 4 | 5 | 3 | 0 | 21/10/2015, 2:45:17, GMT +10:00 | 1/03/2016, 7:06:10, GMT +10:00 |
| tammy.butler@bmo.com | 57 | 5 | 5 | 0 | 12/08/2015, 5:13:06, GMT +10:00 | 2/09/2017, 1:56:38, GMT +10:00 |
| stephanie@wigdahlelectric.com | 31 | 5 | 0 | 0 | 8/11/2013, 7:33:39, GMT +10:00 | 2/09/2017, 7:12:58, GMT +10:00 |
| sally.sh@sta.samsung.com | 0 | 4 | 0 | 0 | 8/11/2014, 7:01:44, GMT +10:00 | 2/09/2017, 1:50:09, GMT +10:00 |
| jnorton@rss-chtd.com | 3 | 4 | 11 | 0 | 24/07/2014, 1:10:44, GMT +10:00 | 2/09/2017, 6:47:17, GMT +10:00 |
| rsternberg@ksnlaw.com | 12 | 4 | 4 | 0 | 4/12/2015, 6:33:35, GMT +10:00 | 2/09/2017, 6:47:01, GMT +10:00 |
| gerry@wigdahlelectric.com | 0 | 4 | 2 | 0 | 15/02/2014, 8:40:36, GMT +10:00 | 2/09/2017, 6:49:30, GMT +10:00 |
| skarlson@hiffman.com | 4 | 4 | 16 | 0 | 19/06/2015, 4:39:25, GMT +10:00 | 2/09/2017, 7:12:58, GMT +10:00 |

### Single Email Overview and Flow Graph

Click this button to generate an overview table and flow graph for a single email address.

The table shows the count of all incoming and outgoing emails sent from a specified email address.

The table and graph can be added to the case via the right click menu.

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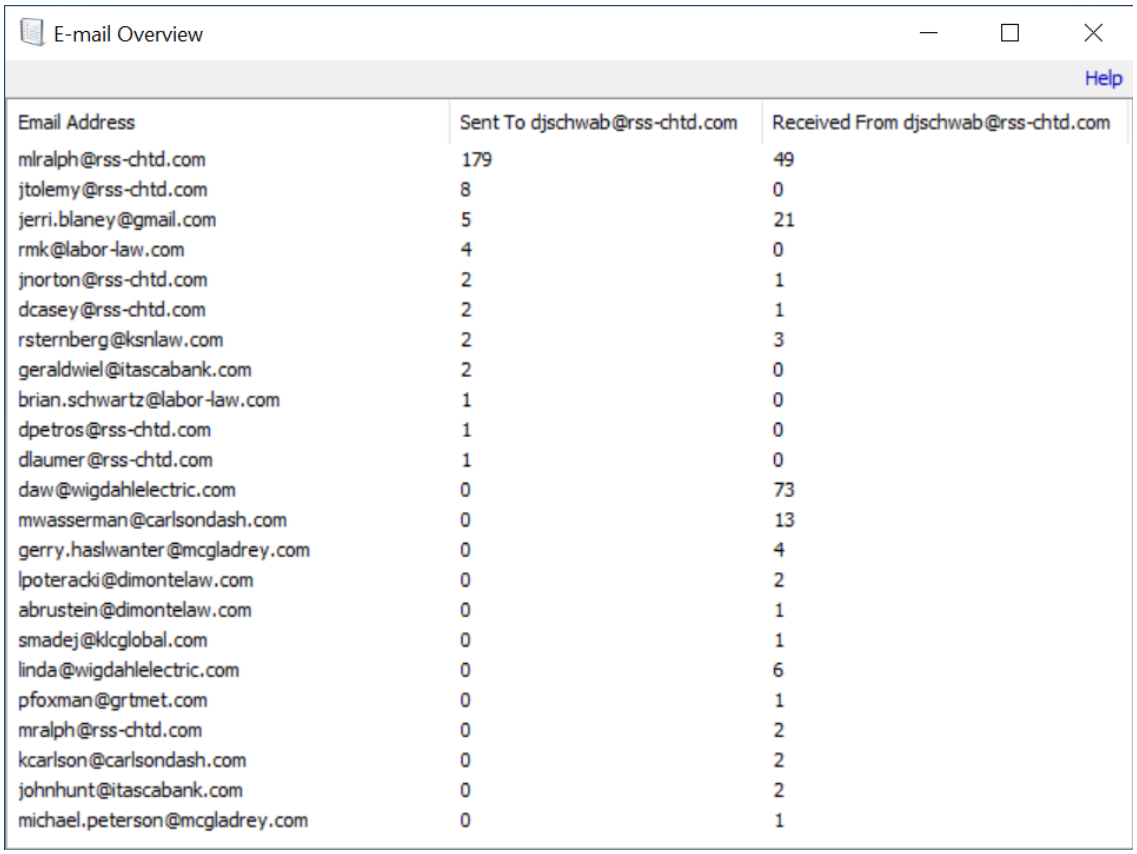
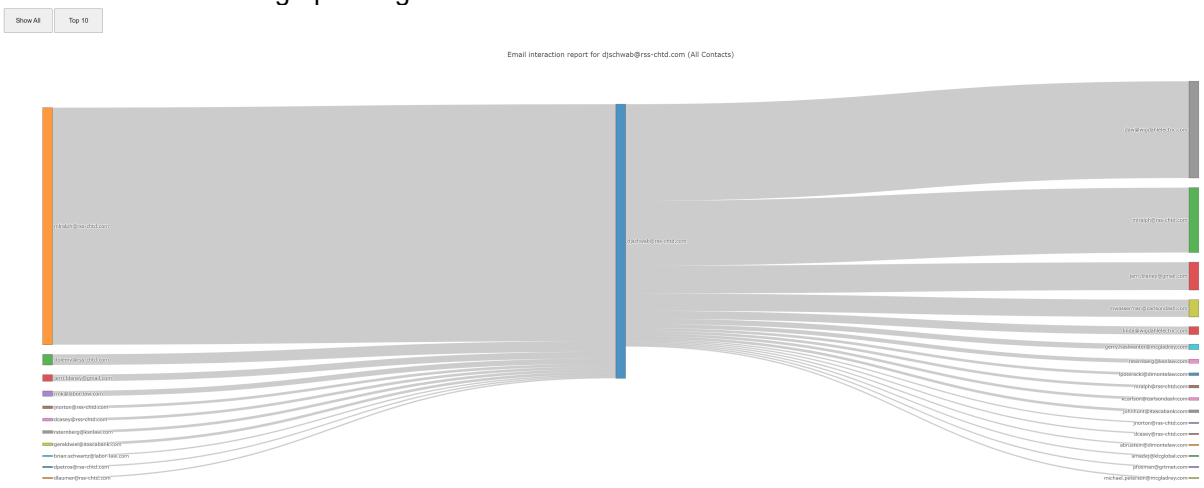



| Email Address | Sent To djschwab@rss-chtd.com | Received From djschwab@rss-chtd.com |
|---|---|---|
| mlralph@rss-chtd.com | 179 | 49 |
| jtolemy@rss-chtd.com | 8 | 0 |
| jerri.blaney@gmail.com | 5 | 21 |
| rmk@labor-law.com | 4 | 0 |
| jnorton@rss-chtd.com | 2 | 1 |
| dcasey@rss-chtd.com | 2 | 1 |
| rsternberg@ksnlaw.com | 2 | 3 |
| geraldwiel@itascabank.com | 2 | 0 |
| brian.schwartz@labor-law.com | 1 | 0 |
| dpetros@rss-chtd.com | 1 | 0 |
| dlaumer@rss-chtd.com | 1 | 0 |
| daw@wigdahlelectric.com | 0 | 73 |
| mwasserman@carlsondash.com | 0 | 13 |
| gerry.haslwanter@mcgladrey.com | 0 | 4 |
| lpoteracki@dimontelaw.com | 0 | 2 |
| abrustein@dimontelaw.com | 0 | 1 |
| smadej@klcglobal.com | 0 | 1 |
| linda@wigdahlelectric.com | 0 | 6 |
| pfoxman@grtmet.com | 0 | 1 |
| mralph@rss-chtd.com | 0 | 2 |
| kcarlson@carlsondash.com | 0 | 2 |
| johnhunt@itascabank.com | 0 | 2 |
| michael.peterson@mcgladrey.com | 0 | 1 |

The flow graph will open in your default browser, it shows a visual representation of the email flow into and from a specified address.

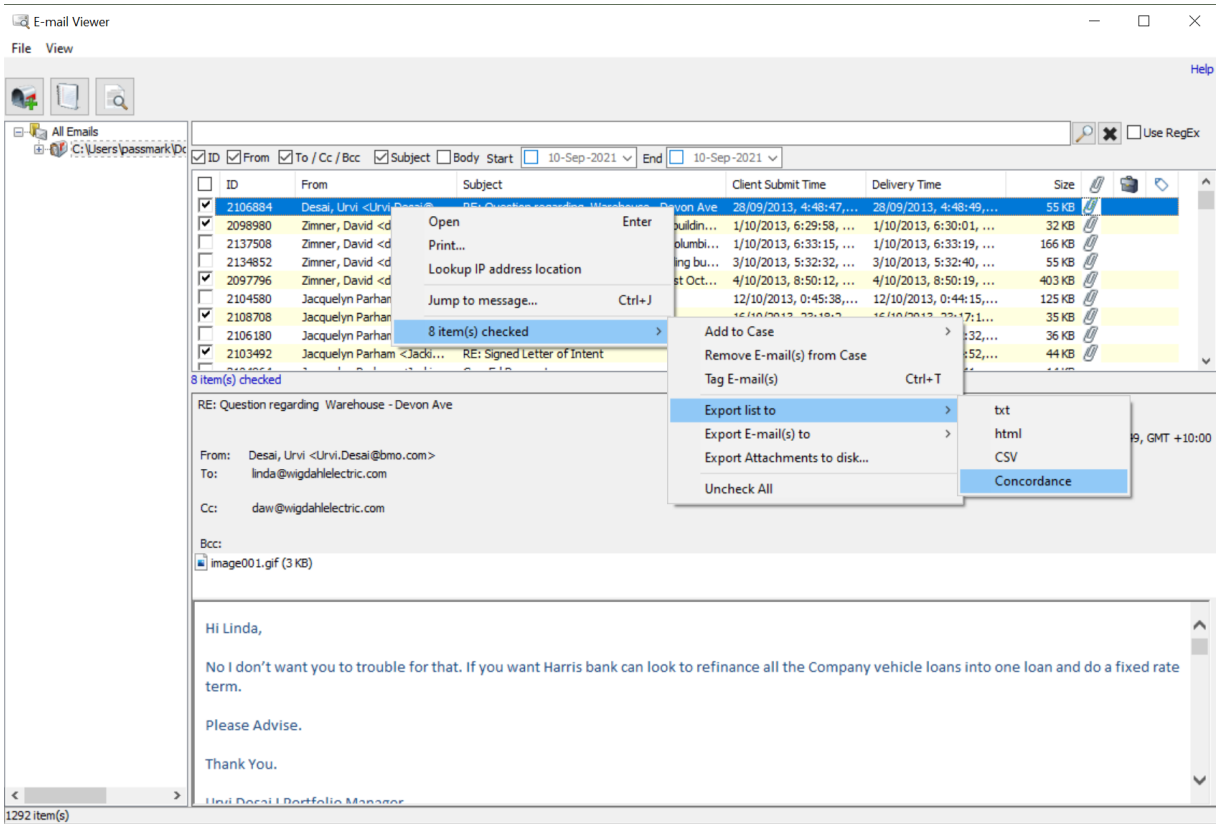
You can limit the graph to show only the top 10 incoming and outgoing addresses using the button in the top left.

You can also zoom the graph using the mouse scroll wheel.



### Exporting E-mails to Concordance Load File

Emails can be exported to a Concordance load file for use in eDiscovery software.
Select the emails to be exported and right click to view the menu.




## 5.9 ESE Database Viewer

The ESE Database Viewer provides visibility into databases stored in the Extensible Storage Engine (ESE) file format. The ESEDB format, in particular, is used by several Microsoft applications that store data with potential forensics value, including the following:

- Windows (Desktop) Search
- Windows (Vista) Mail
- Microsoft Exchange Server

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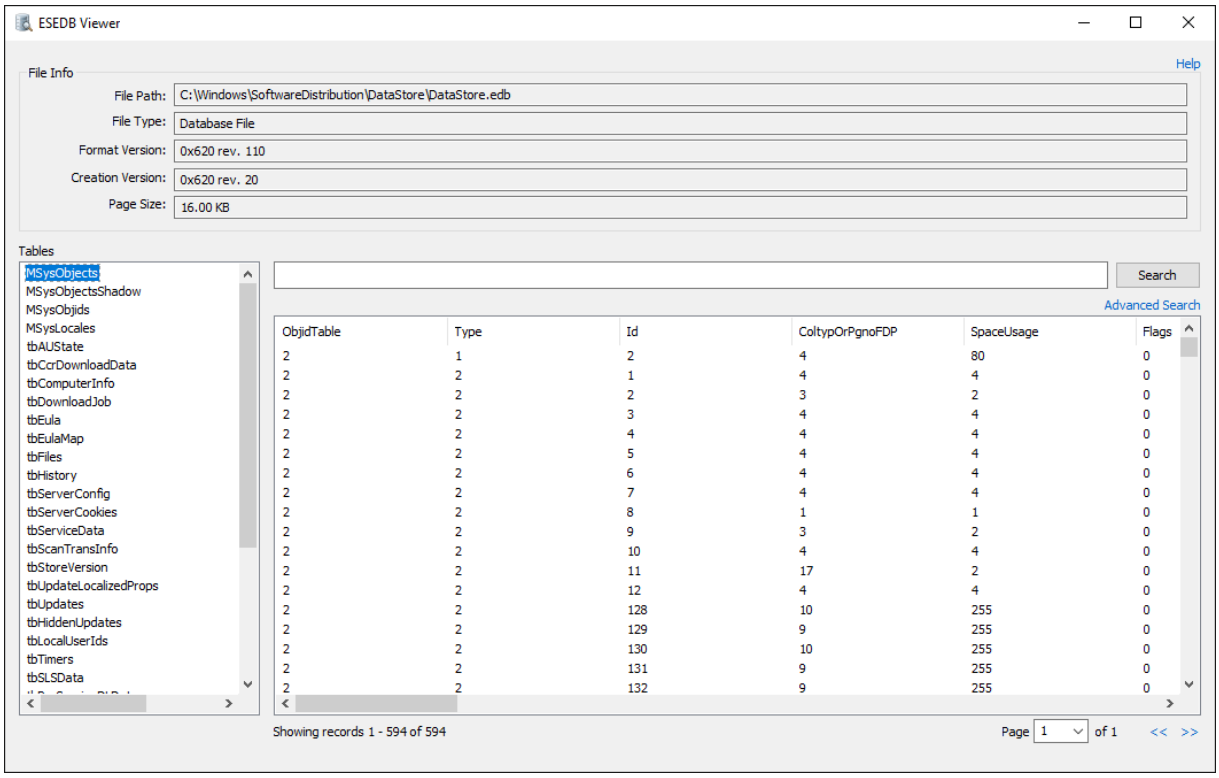


## Understanding the ESE Database Viewer

The table below summarizes the main components of the ESE Database Viewer

| Component | Description |
|---|---|
| File Info | Displays the details of the ESE database |
| Tables List | Displays a list of table contained in the database |
| Records List | Displays a list of records contained in the selected table |

## Opening the ESE Database Viewer

The ESE Database Viewer can be accessed via the "ESEDB Viewer" icon in the "Viewers" group under the Start tab.

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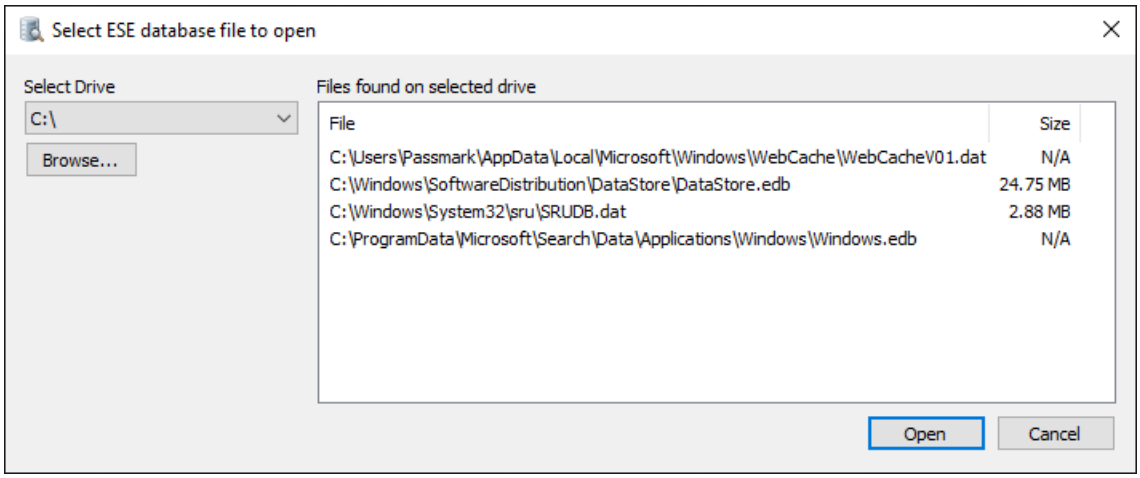


Once opened, a list of known database files are displayed for the selected device. Alternatively, the database file can be manually selected by clicking the 'Browse' button and locating the file itself.

When attempting to open a file with a known ESE database file extension using the internal viewer, the user may be given the option to open the file using the ESE Database Viewer instead.

## Usage

Once the database file is opened, the Tables list is populated with the tables contained in the database. To view the records contained in a particular table, select a table from the Tables list. Known tables with useful data are highlighted in red.

Note: For some known tables, only a subset of the most common columns are displayed (due to having a large number of columns). This message is shown on the bottom of the viewer. Clicking on the message allows for selecting the columns to display.

### Search

To perform a simple text search of all records in the table, enter a search term and click 'Search'. This will locate records that contain the specified text as it is displayed on the table. A more comprehensive search can be performed based on the data type (eg. number, boolean, dates) of the fields by clicking on Advanced Search...

### Right-click Menu

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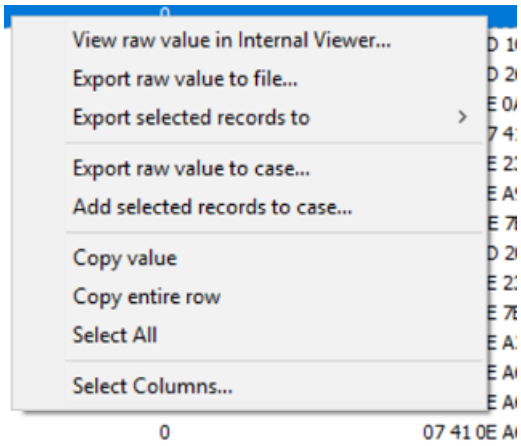


**Copy row**
Copies the entire row as text to the clipboard

**View raw value in Internal Viewer...**
Opens the column value under the mouse cursor (szKey, Data etc) in the OSForensics internal viewer.

**Export selected records to**

**txt**
Saves the list of selected records to a text file

**html**
Saves the list of selected records to an html file

**CSV**
Saves the list of selected records to a CSV file

**Export raw value to case...**
Adds the column value under the mouse cursor (szKey, Data etc) as a .bin file to the exported items for the currently active case.

**Add selected records to case...**
Adds the list of selected records to the case as a CSV file

**Select All**
Select all of the records in the ESE Database file

**Select Columns...**
Select a subset of the columns to display

## Selecting Columns

By selecting a subset of the columns to display, the user can focus on viewing the important fields of a a database record and ignoring the less relevant ones. To specify the list of columns to display, move the appropriate columns to the 'Selected Columns' list, while leaving the columns to be excluded in the 'All Columns' list.

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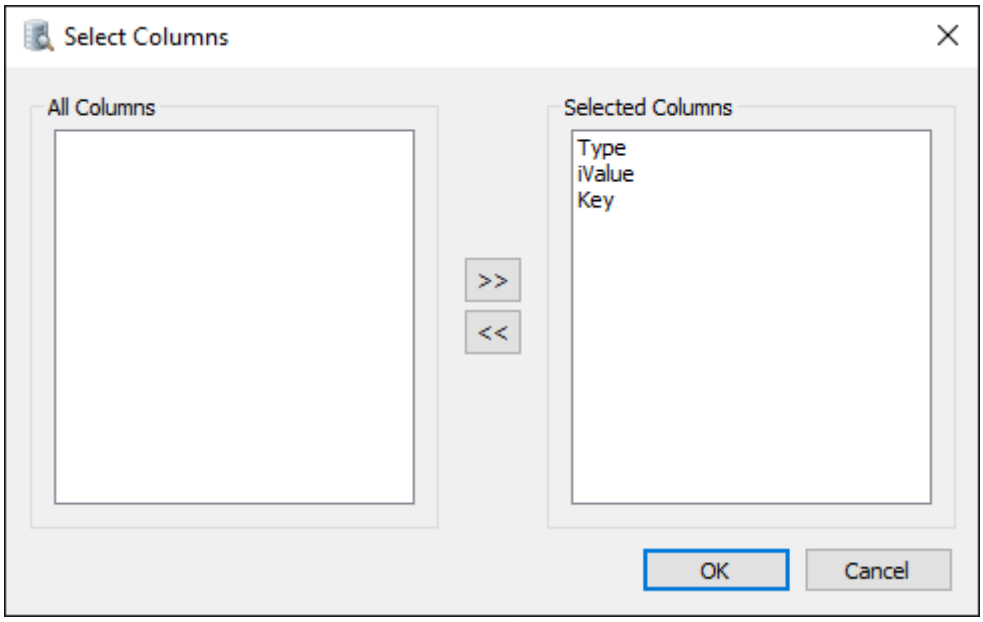


### 5.9.1 ESE Database Advanced Search

The ESE Database Advanced Search dialog allows the user to perform a more powerful search of database records based on one or more data type specific criteria.

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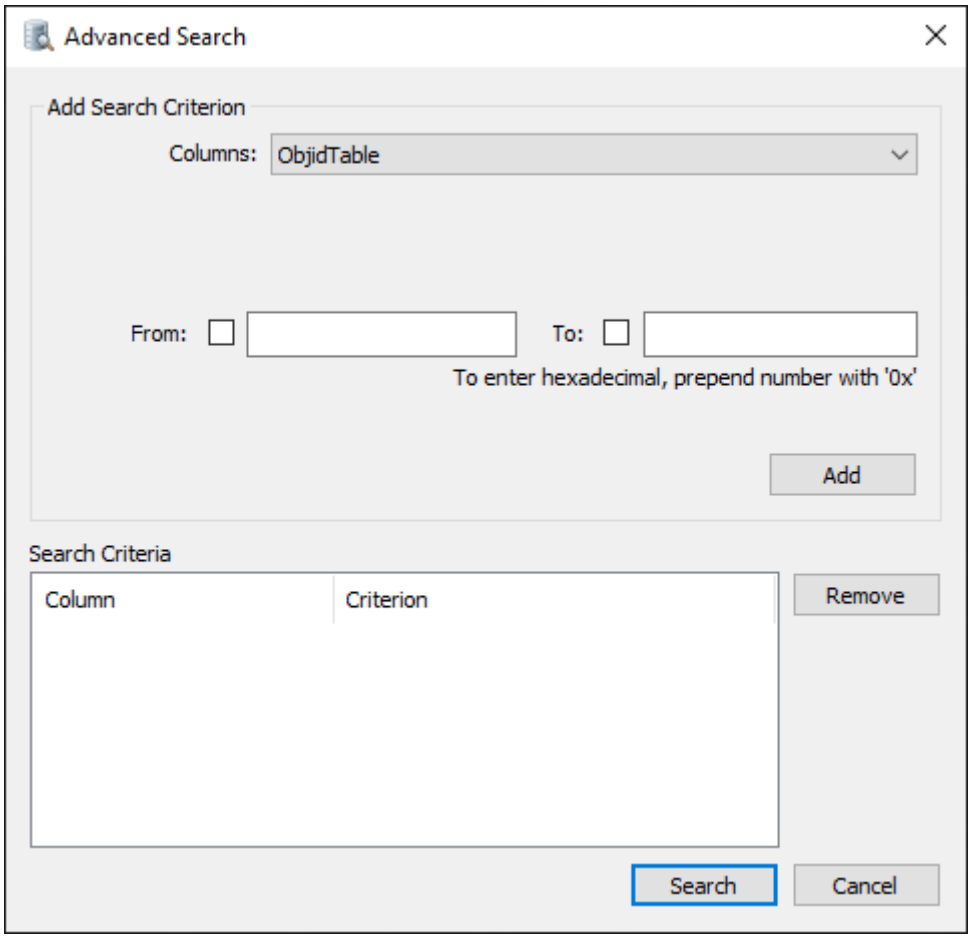


To add a criterion, first select a column from the list. Based on the selected column's data type (eg. integer, date, boolean, text), a condition that must be satisfied by the record value can be specified. Once the condition has been specified, click 'Add' to add to the search criteria. To perform the search using the specified criteria, click 'Search' to perform the search. Once the search has been completed, the results are displayed in the ESE Database Viewer.

## 5.10 Event Log Viewer

The Event Log Viewer allows users to view and examine event logs created by Windows Vista and beyond. It supports event logs with file extension .evtx located in the **%System32%\winevt\Logs** directory.

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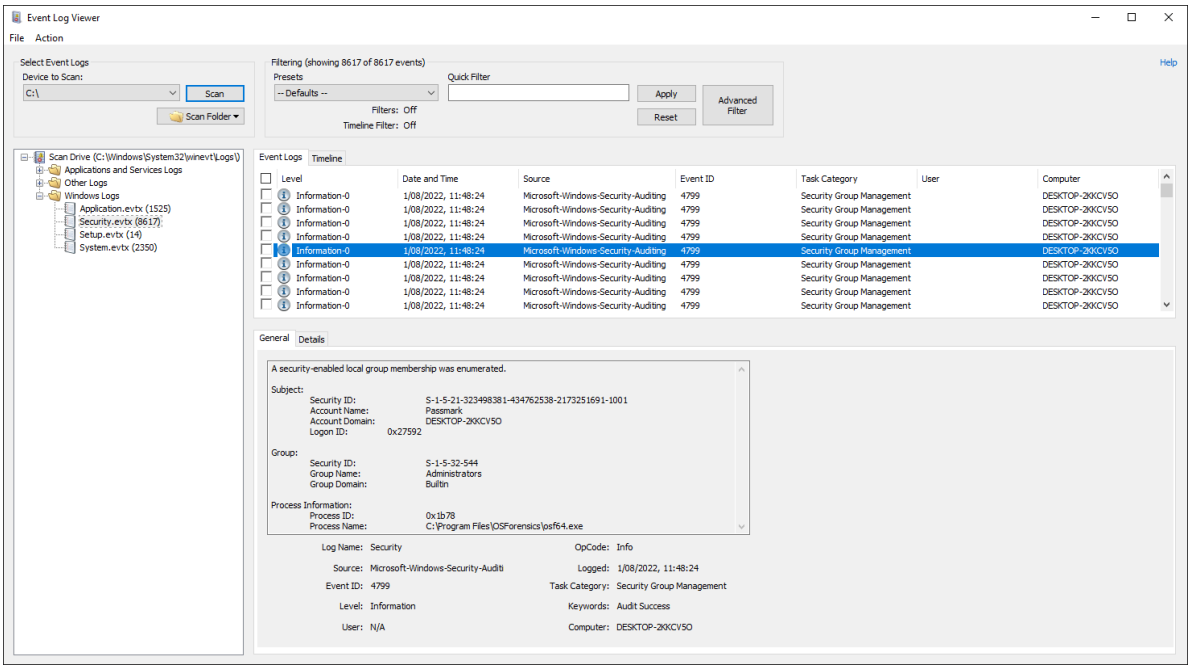

Event Log Viewer

# Usage

### Scan Drive

To scan Windows Event Log files, select a Drive from the drop-down list and click 'Scan'. OSForensics Event Log Viewer will search the default **%System32%\winevt\Logs** directory for event log files.
The found event log files will be listed on the left-hand tree-view pane with the file name followed by a number in brackets showing the number of logs in that file.
The tree-view items are grouped into four different sections "Applications and Services Logs", "Windows Logs", "Archived Logs" and "Other Logs". The grouping is done based on the file names.
Note that when searching Event Log files in the Scan process, it only checks the file extension .evtx of the files in the directory, it does not verify whether or not the file is a 'true' Event Log file (e.g. ABC.txt renamed as ABC.evtx).

### Scan Folder

To scan a folder, select a folder to scan by clicking Scan Folder button in the main dialog or from the top menu.

### Add Log

To add an event log file, select a file to open by clicking Add Log button in the main dialog or from the top menu.

### View Logs

To view list of logs in the event log file, click one tree-view item on the left-hand pane. After then, you can perform sorting and filtering of the results.
If you click one log item from the list-view, right-bottom preview pane will show the detailed properties of the selected log. Shifting to 'Details' tab allows you to view the XML information of the event.

### Filtering

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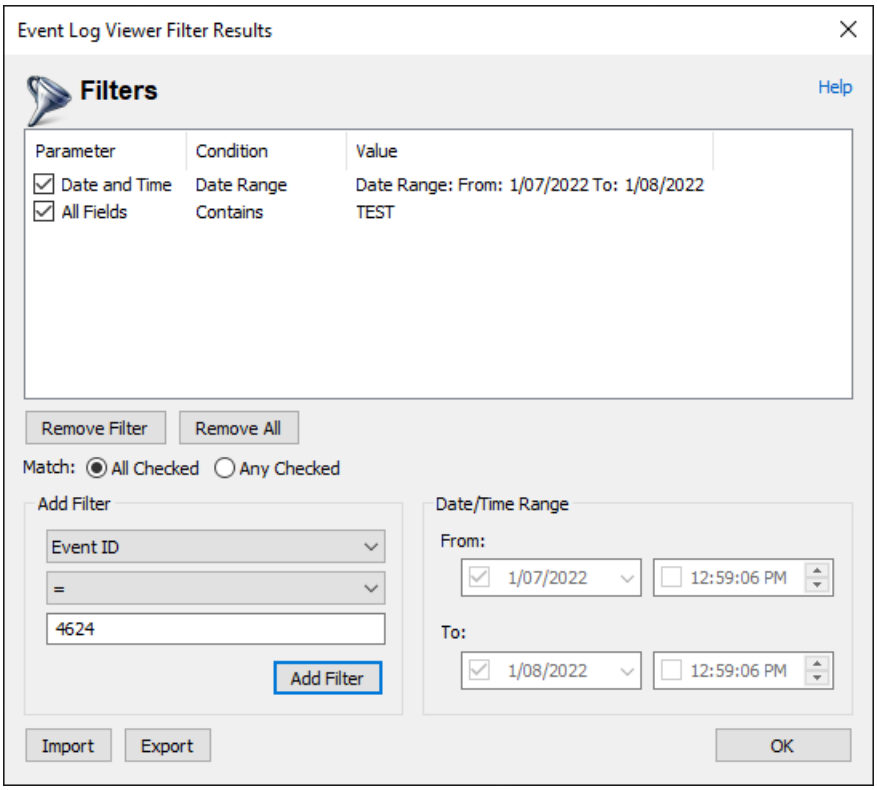
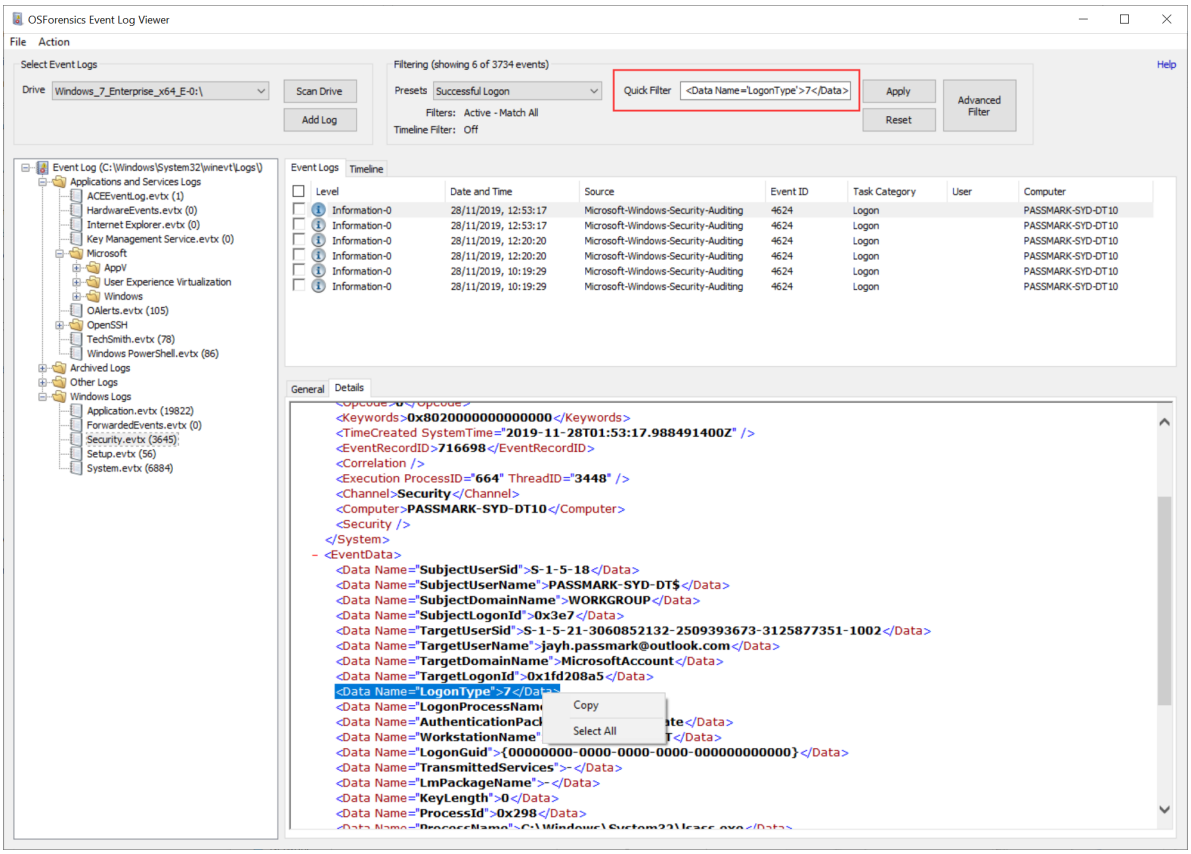
Filtering is where you will spend the most amount of time, culling down voluminous logs to something more manageable. To filter the event logs list, click the 'Advanced Filters' and then add filters by selecting different filter conditions. Once you've selected the conditions click 'Add Filter' to add the filter to the Filters list-view.
Filters are also able to be exported to a file and then imported as required.

Alternatively, you can use 'Quick Filter' to filter the results. The operation of performing Quick Filter is the same as adding an advanced filter with Parameter set as "All Fields", Condition set as "Contains" and the entered keywords as the "Value", which will search against fields including "Level, Date and Time, Source, Event ID, Task Category, User, Computer, Event Record ID and **XML information**".
For investigators, allowing to search through XML message might be very useful and it can be very efficient in some cases.
* Tip: if you're going to search keywords which include XML syntax, please replace the double quotation marks with single quotation marks, such that you could get the desired results. (e.g. <Data Name='LogonType'>7</Data>)

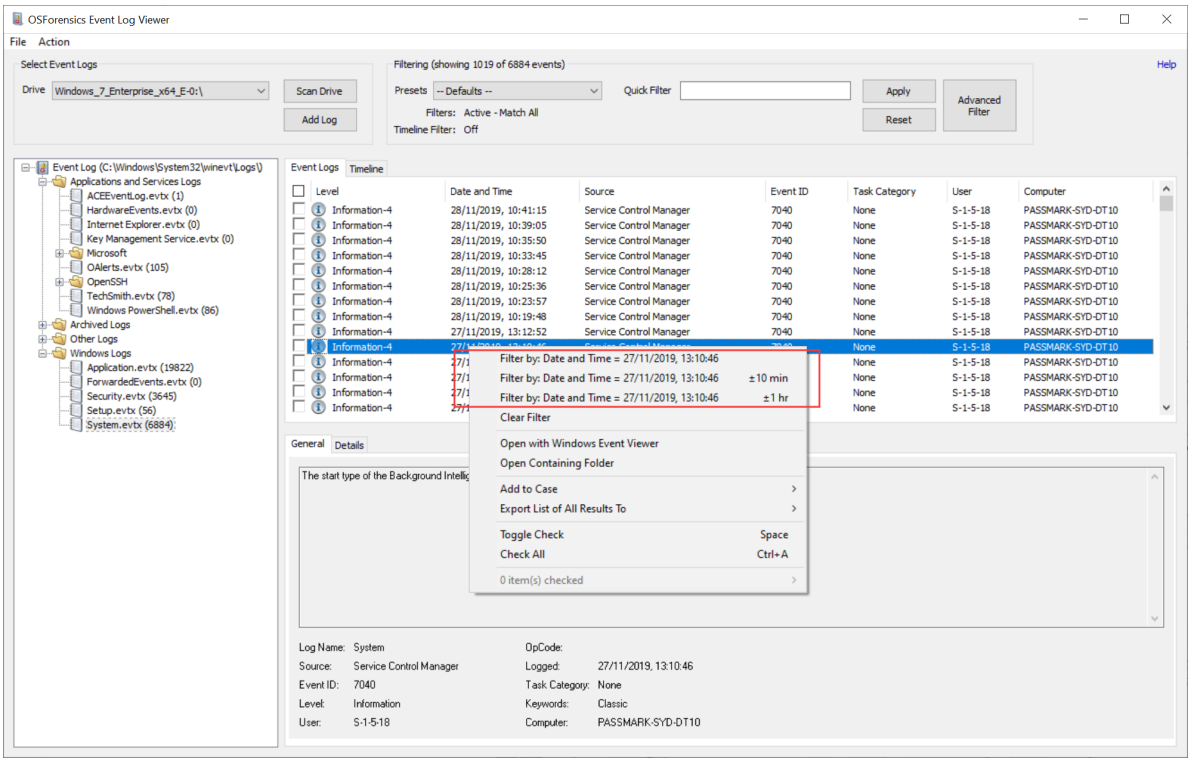
Filter by... option is another way to quickly narrow down the scopes for searches. Right-click on the specific column of a specific event record, you could quickly add a relevant filter to the advanced filtering list.



Adding filters




Quick filter




Filter by...

**Presets**

Presets are list of predefined filters which can be customized by users. Preset works after a drive has been scanned, and it works on the last scanned drive.

To customize the preset list, there are two steps to do:

Step 1. Edit the Presets config file in the ProgramData directory which usually located at:
C:\ProgramData\PassMark\OSForensics\EventLogPresets.txt

Three lines as a set for one preset entry, the first line is the name of the preset filter, second line is filter file name, and the third needs to be the name of the event log file in which the events are stored.

Step 2. Create filter file and put in the directory "EventLogPresetFilters" located at:
C:\ProgramData\PassMark\OSForensics\EventLogPresetFilters\

You could create a filter file by exporting from Event Log Viewer, or editing the sample file.
* Note that the FilterType value should be set as 2 indicating this is a Preset filter.

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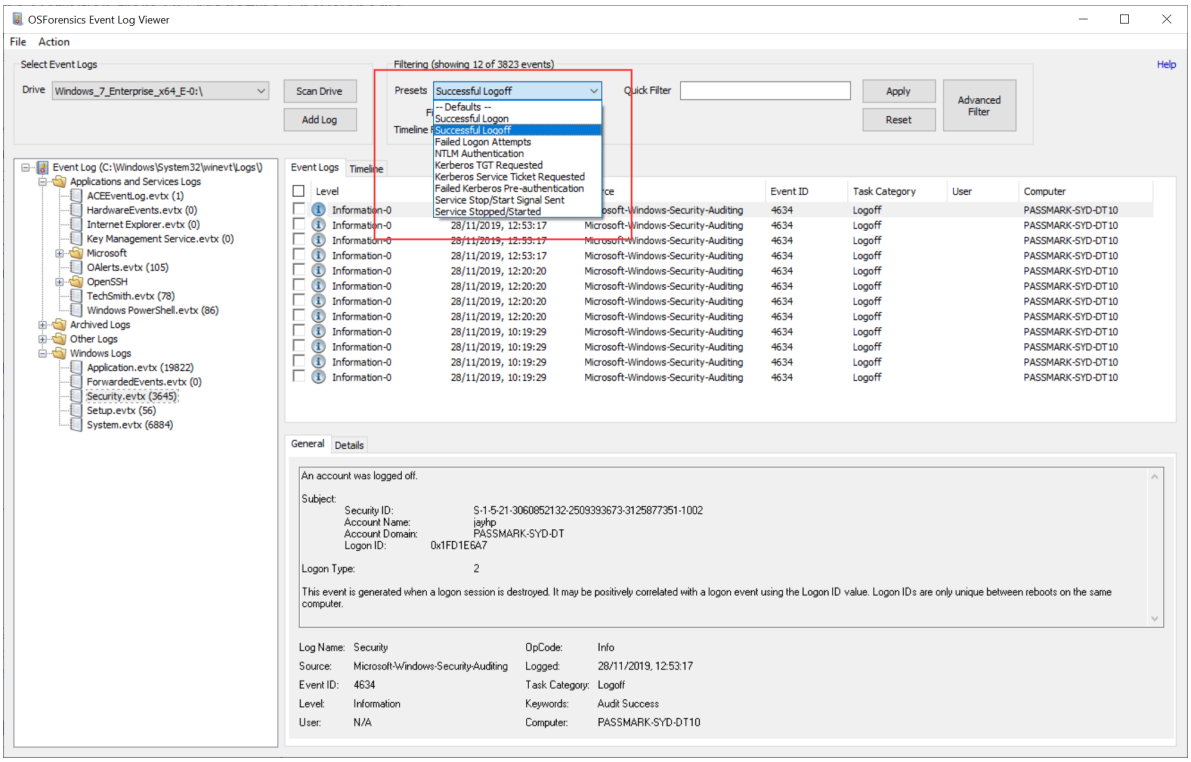


Preset filter

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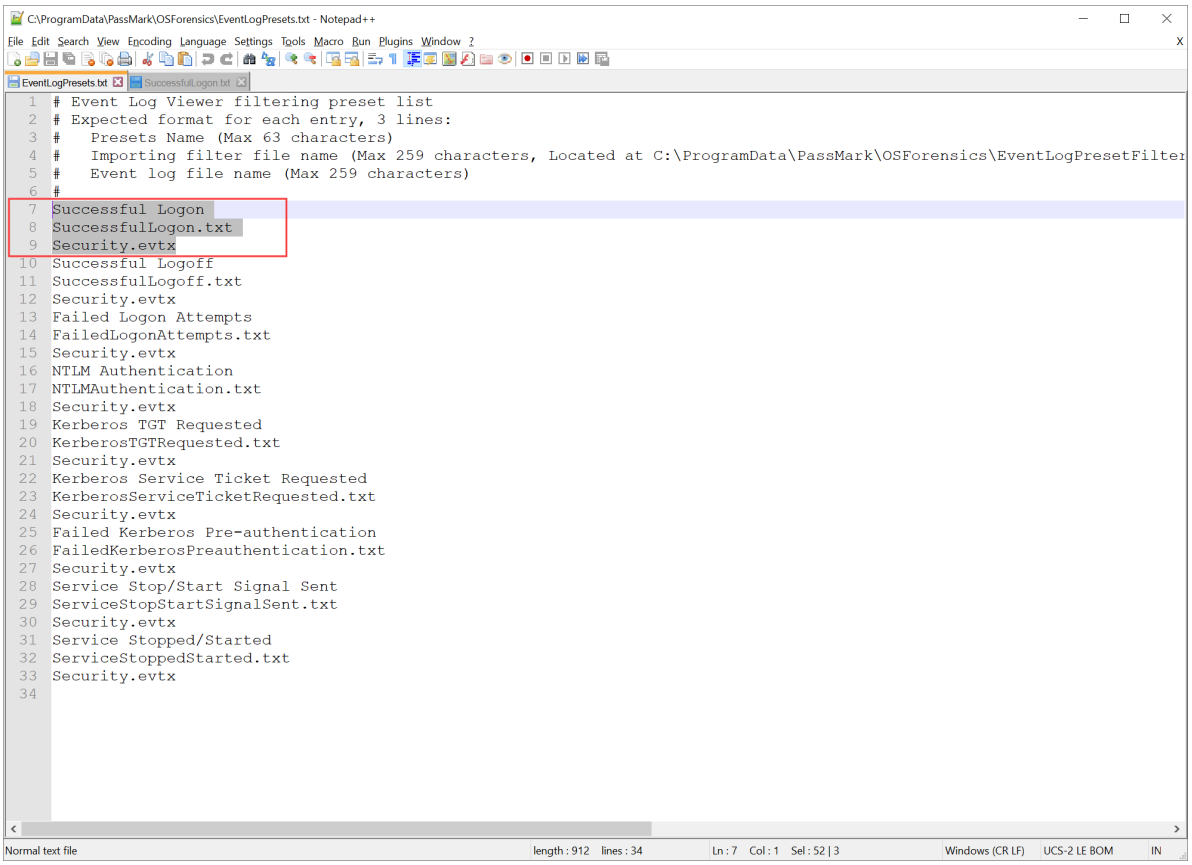
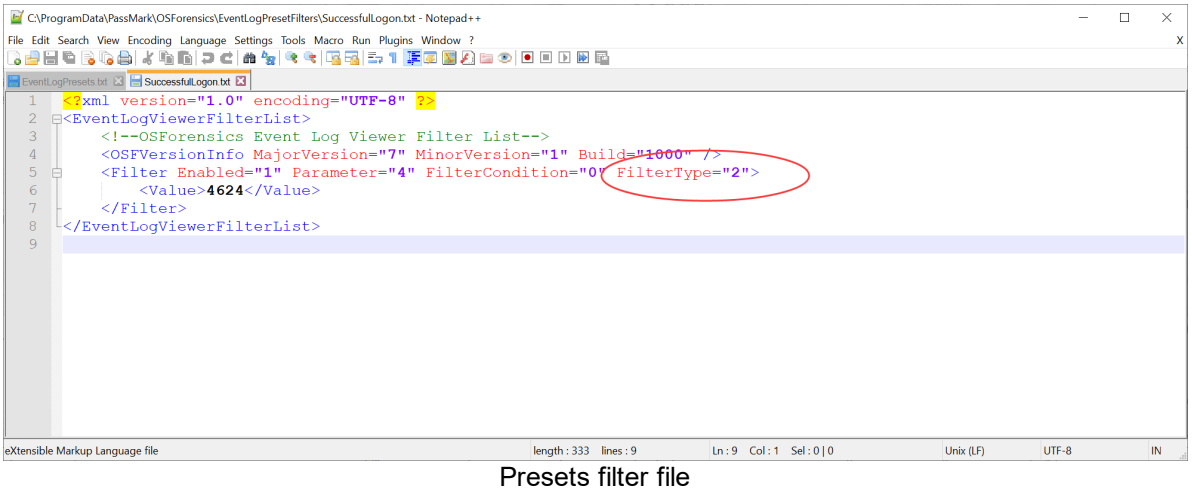



Customize presets




Presets filter file

**Time Line**

Timelines are graphical representations of events in chronological order.
The Timeline view displays an interactive bar graph providing users with a time-based view of Event Logs. This view is useful for identifying trends where significant number of events occurred. Each bar is color-coded by the different Level of events.

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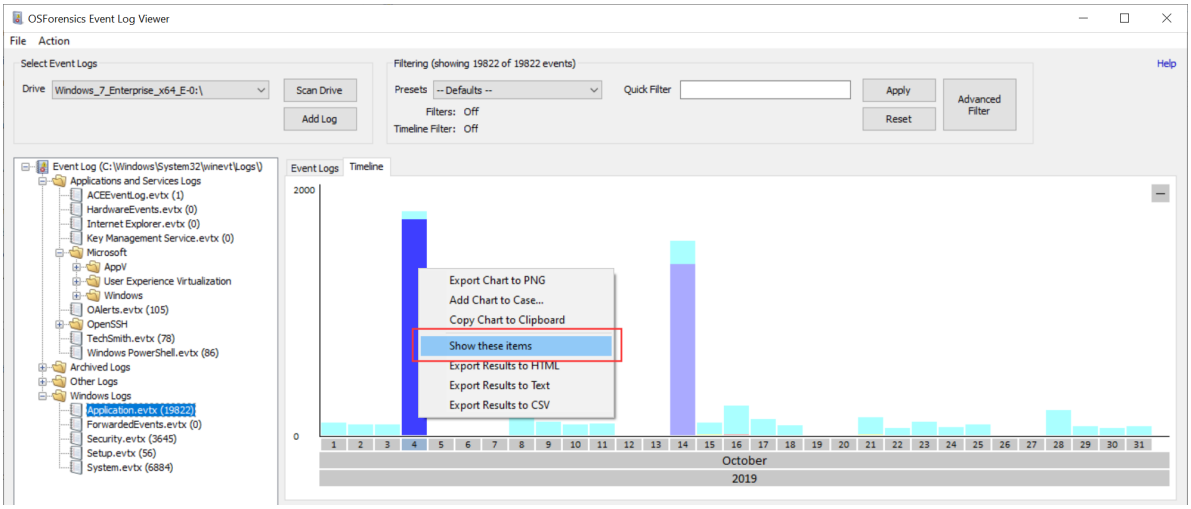
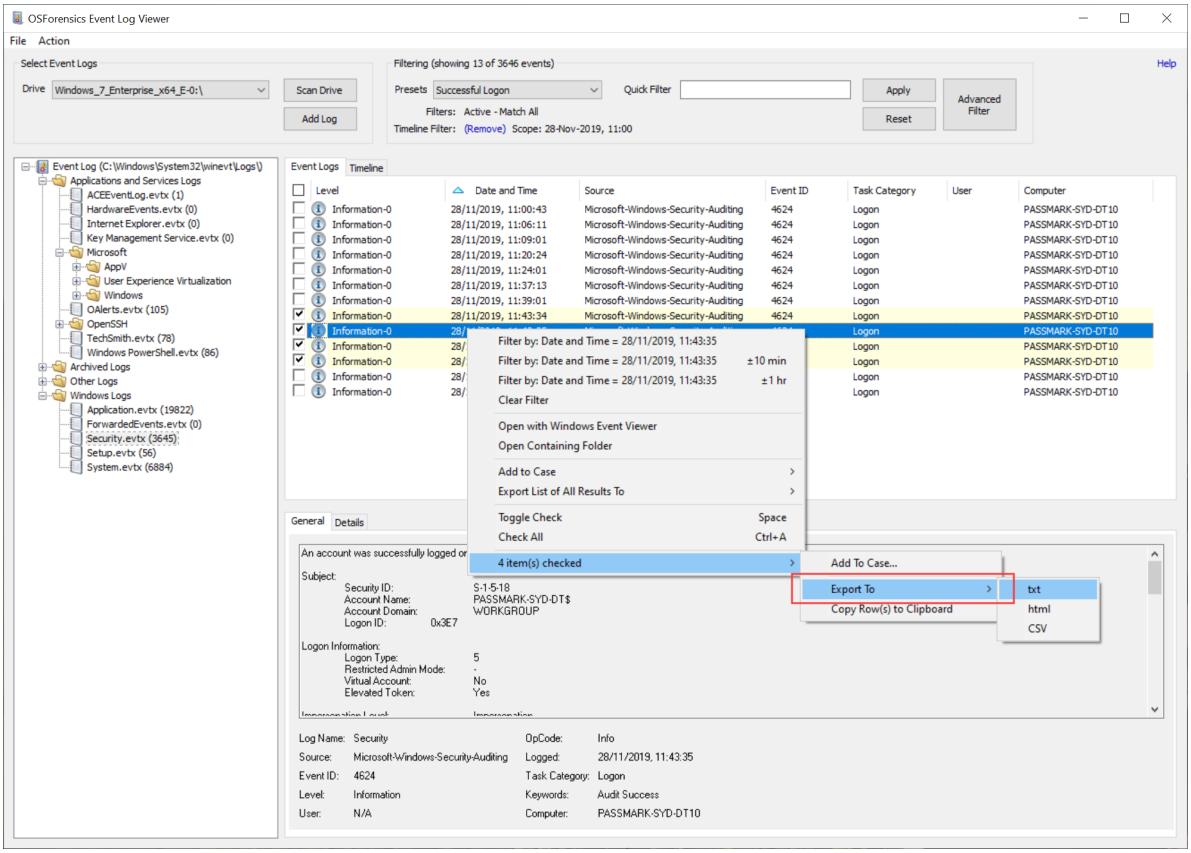



Timeline right click menu

**Export to CSV/HTML/Text**

To export the logs to a file with format CSV, HTML or txt, select some or all logs and right-click on the list.




Export results to

## Additional Info

**Level**
Level field shows the type of event that is recorded. There are five different types - Information, Critical, Error, Warning and Verbose.
OSForensics Event Log Viewer displays a number followed by these types names, that is the number retrieved from Level field in System section of XML message.
Note that both '0' and '4' numbers indicate the same Information type.

**Date and Time**
When the logs are recorded by Windows systems the time stamp is stored in GMT.
OSForensics Event Log Viewer uses whatever time zone is currently set in the Case Properties of Manage Case module. If you are going to change the time zone setting, please close the Event Log Viewer and reopen it after the setting is done.

**Event ID**
It is recommended to perform analysis on a version of Windows that is at least as new as the computer that generated the event logs to be analyzed. This is because the Event IDs have been added over time and the information representing each ID has also been changed.
For additional information on Event IDs please visit: http://www.eventid.net/

**User**
User field in OSForensics Event Log Viewer is showing Security Identifiers (SIDs). For the well-known SIDs please visit: https://support.microsoft.com/en-gb/help/243330/well-known-security-identifiers-in-windows-operating-systems

**Using Regular Expression**
Event Log Viewer supports Regular Expressions search. Here is an example of searching logs that contain IP addresses.
By using keyword ((0|1[0-9]{0,2}|2[0-9]{0,1}|2[0-4][0-9]|25[0-5]|[3-9][0-9]{0,1})\.){3}(0|1[0-9]{0,2}|2[0-9]{0,1}|2[0-4][0-9]|25[0-5]|[3-9][0-9]{0,1}) with the regular expression condition, we easily got the interesting 10 records which include IP addresses among 38,566 records.

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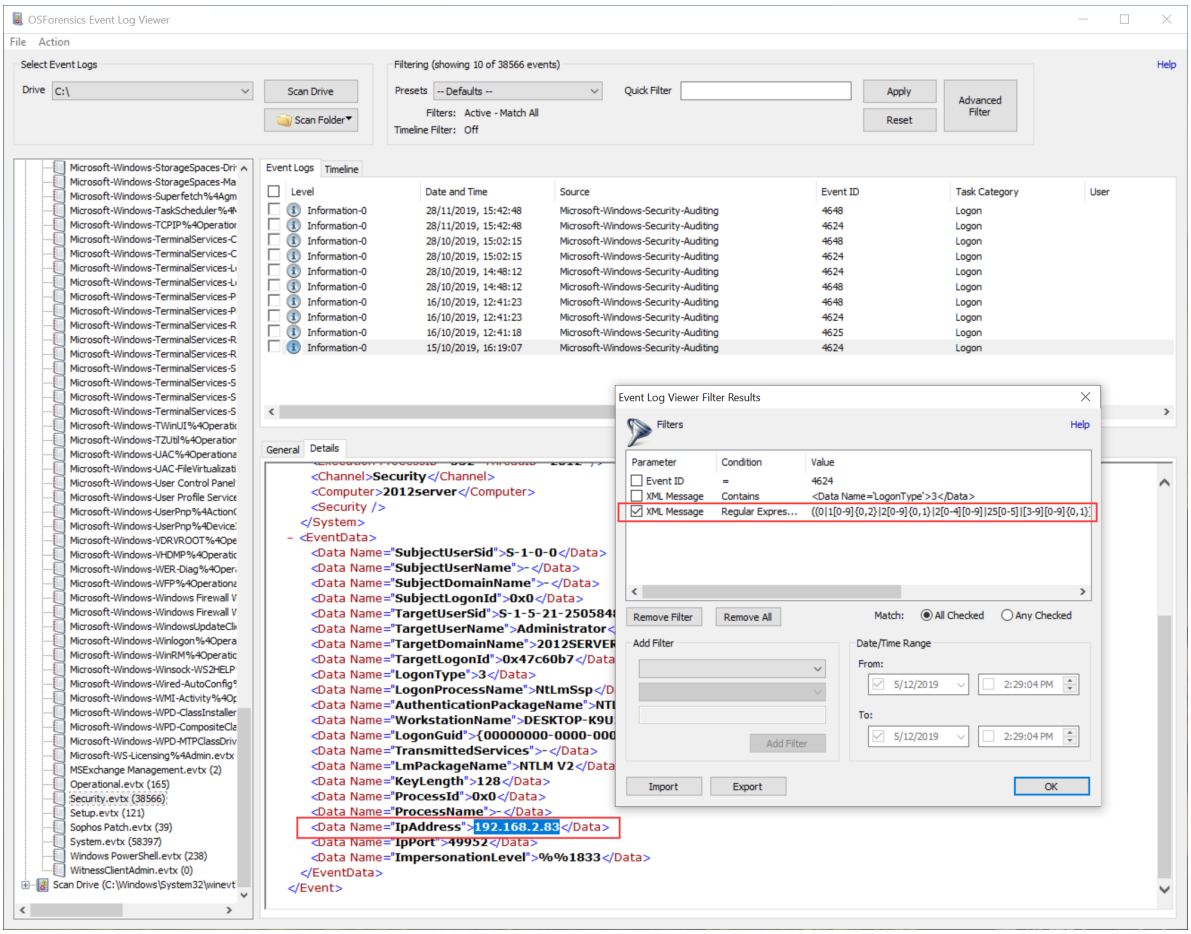
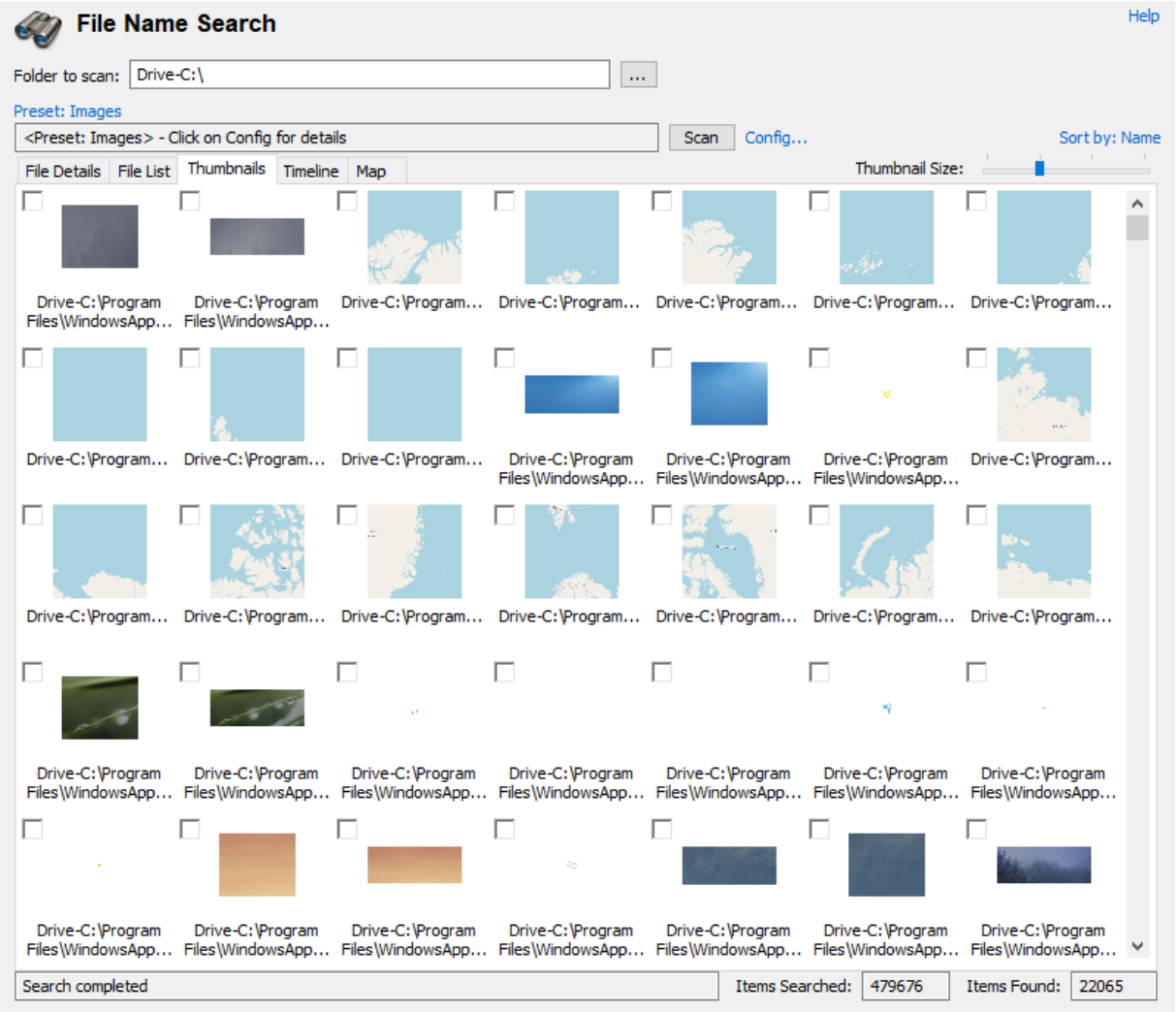



Regular Expression

## 5.11 File Name Search

The File Name Search Module can be used to search for names of files and folders that match the specified search pattern.




## Basic Usage

A basic search simply involves entering a search string and location. Any files or folders that contain the search string within their name will be displayed in the search results. For instance, searching for "File" will match "file.txt", "test.file" or "MyFile.doc". The basic search is case insensitive.

**Multiple Searches**
To run multiple different searches at once by separating the terms with the ';' character.

**Wildcards**
You can use '*' or '?' as wildcards within the search string.

'*' represents any number of characters
'?' represents a single character

If a wildcard is entered anywhere in the search field, wildcard matching is enabled on all search terms. When wildcard matching is enabled, you will need to explicitly add '*' to the start and end of the search term if you are trying match a word that may appear in the middle of a filename.

*Note: The search string can only be specified when Preset is set to User-defined Search*

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**Presets**
You can select one of the preset search options to quickly locate files of certain file type (eg. image files or office documents). Presets are loaded from a default Preset file and user customs presets are loaded/stored from the OSForensics config file. Adding or editing custom presets can be done so in the File Name Search Configuration window.

The default presets are loaded from the `FileNameSearchPresets.cfg` file in the OSForensics program data folder (generally `C:\ProgramData\PassMark\OSForensics`). The default presets can be customized by altering the file. This file needs to be opened and saved in Unicode format. The `FileNameSearchPresets.cfg` may be overwritten upon upgrade or new installs, it is recommend adding custom presets using the configuration window.

**Image Analysis Presets (Face-Detect-AI, Illicit-Detect-AI)**
For more information on "Face detect" and "Illicit Image" detection options, please see the Image Analysis module.

## More Advanced Options

By clicking the "Config..." button you will be taken to the File Name Search Configuration window where more advanced options can be selected.

## Searching Devices Not Already in Case

Searching devices not already in a currently open case is possible using one of these two methods:

- Clicking "Add device to case..." which brings up the OSForensics "Add Device" dialog box
- Clicking "Select device for searching using non-forensic Windows file access..." which uses the non-forensics mode, Windows API file access method to search the specified device or drive

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Note that if searching in Standard Mode, directories that are reparse points (e.g., OneDrive folders that are not saved locally) would be skipped. To search through these folders, add the device to the case in Forensics Mode instead.

## Results

The results of the search are displayed in one of several views, along with a summary of the number of items searched/found. Right-clicking a file opens the following context menu.

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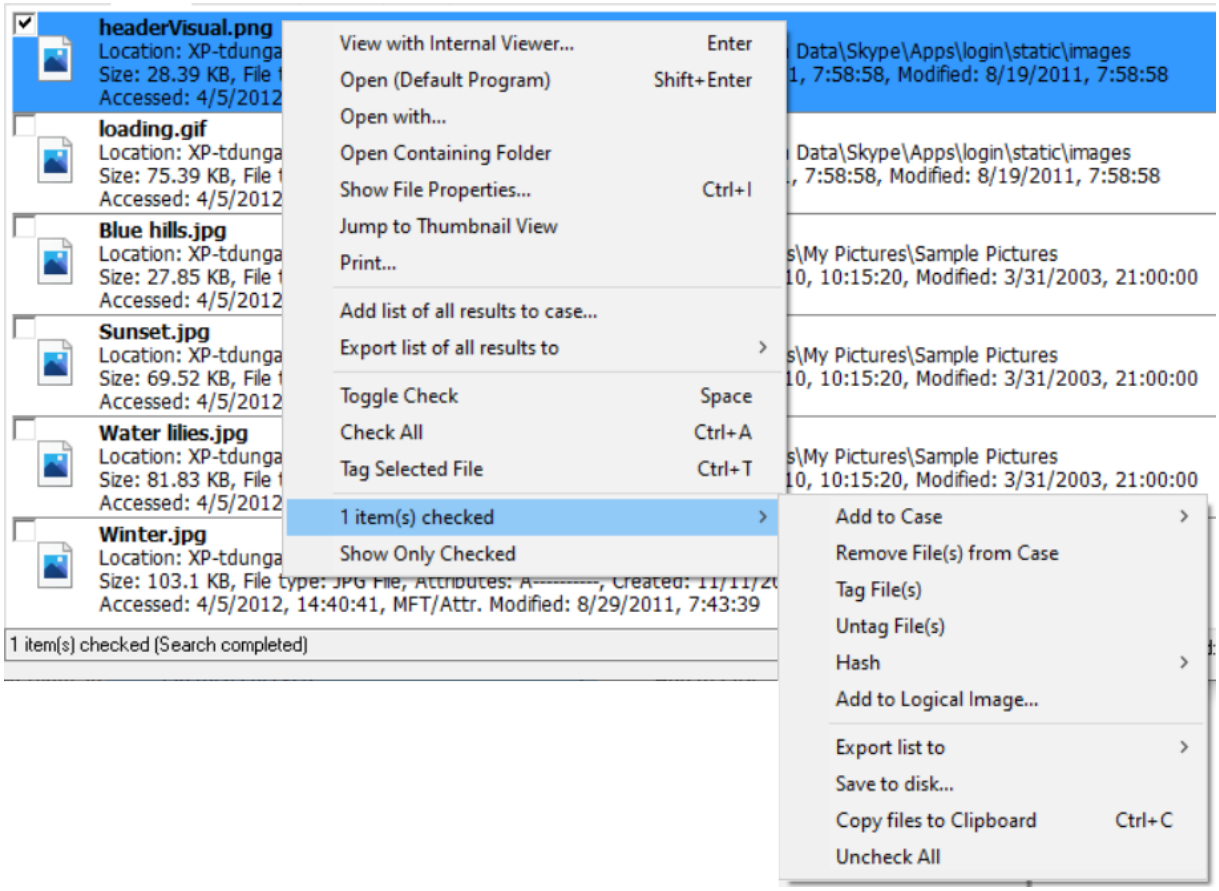


**View with Interval Viewer**
Opens the file with OSForensics Viewer to perform a more thorough analysis

**Open (Default Program)**
Open the file with the default program

**Open With...**
Allows the user to select the program to open the file

**Open Containing Folder**
Opens the folder than contains the file

**Show File Properties**
Opens the file with OSForensics Viewer in File Info mode.

**Jump to Thumbnail View/Jump to Details List**
Show the current file selected in the Thumbnail View or Details List tab

**Print...**
Print the file (if applicable)

**Add list of all results to Case...**
Add the list of results as an HTML or CSV file to case

**Export list of all results to**

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Export the list of results to a TXT, CSV or HTML file

**Toggle Check**
Toggle the check state of the selected item.

**Check All**
Check all the items in the list.

**Tag Selected File**
Tag the selected item.

**n Item(s) checked**

**Add to Case**
Add the checked file(s) or list of checked file(s) to the case, see Adding items to a case.

**Remove File(s) from Case**
Remove the checked file(s) from the case

**Tag File(s)**
Tag the checked file(s). *Keyboard shortcut: Ctrl+T*

**Hash**

**Look up in Hash Set...**
Verify whether the checked file(s) are contained in a hash set in the active database. See Hash Set Lookup.

**Calculate Hash of File(s)...**
Calculate the hash of the checked files.

**Export list to...**
Export the list of checked file(s) to a TXT, CSV or HTML file

**Save to disk...**
Save the checked file(s) to a location on disk.

**Copy File(s) to Clipboard**
Copy the checked file(s) to clipboard. Once copied to the clipboard, the file(s) can be pasted to any other application that supports it (eg. Windows Explorer).

*Note: In some cases, copy and pasting files to an explorer window may fail without an error message when "preparing to copy". This may happen if the file has already been deleted (eg a temp file) or if Windows Explorer does not have permissions to access the files (eg restricted system files and folders). In these cases, it is better to use the "Add to case" function.*

**Uncheck All**
Uncheck the checked file(s).

**Show only Checked/Show All Files**
Toggle to show only the checked items or to show all files

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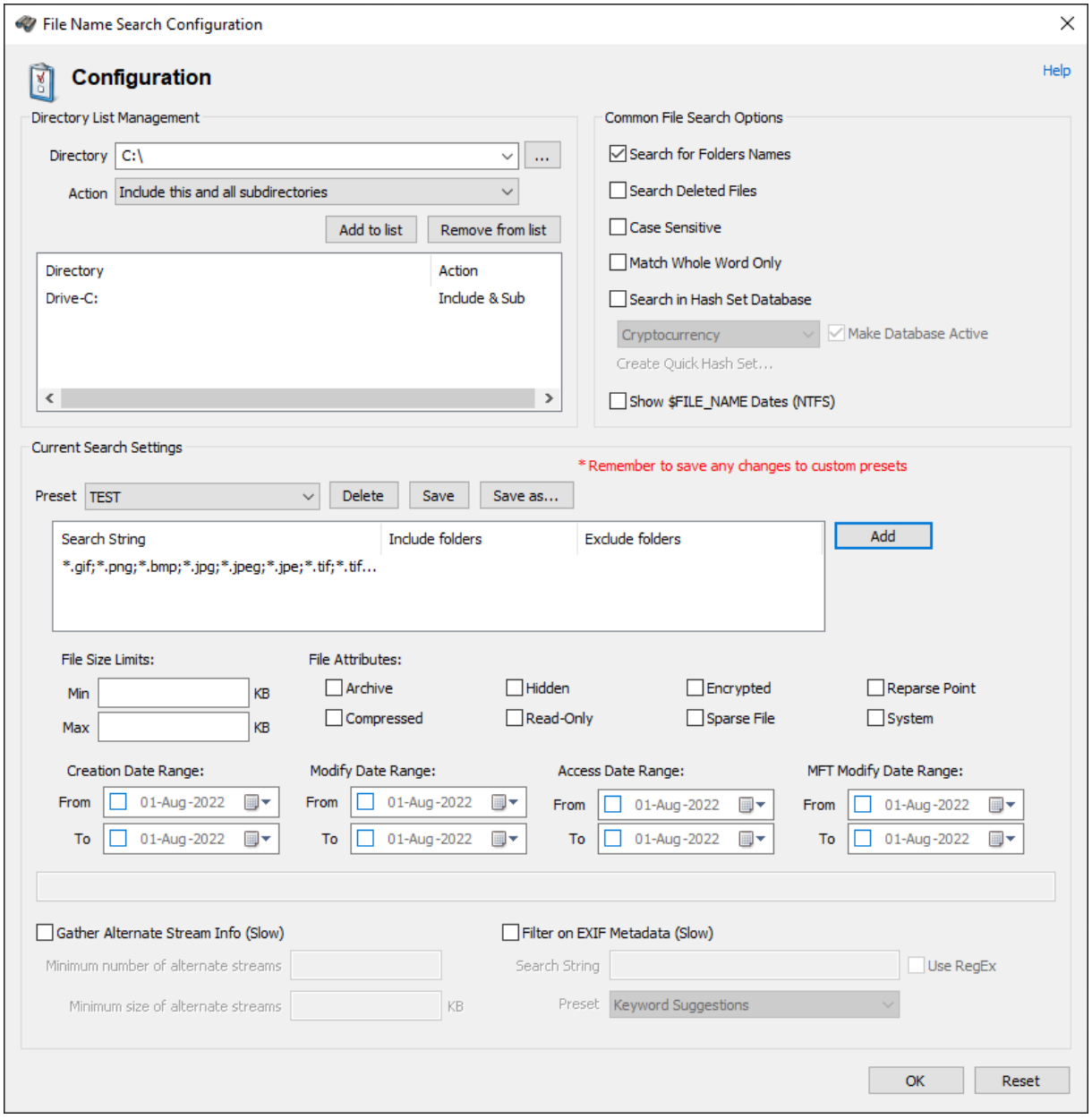
### 5.11.1 File Name Search Configuration

The File Name Search Configuration Window allows for setting advanced options for the File Name Search. This window can be accessed by clicking on the "Config..." button in the main File Name Search window.




**Directory List Management -** List of Directories to be included or excluded from the search

**Directory**
Specify the directory to be included or excluded

**Action**

Options are: *Include this directory, Include this directory and all sub-directories, Exclude this directory* and *Exclude this directory and all sub-directories.*

Sub folders will also be included or excluded in searches, not just the files in the start directory.

**Add to List**
Add the currently Directory and Action to the list

**Remove from List**
Remove the currently selected start point in the list.

## **Common File Search Options -** Options that are applied to every search preformed by File Name Search.

**Search for Folder Names**
If checked, folder names will also be included in searches, not just file names. This option is enabled by default.

**Case Sensitive**
If checked, searches will be case sensitive. This option is disabled by default.

**Search deleted files**
If checked, deleted files (and $I30 slack entries, for NTFS drives) will also be included in the results. Enabling this option may reduce the speed of the search.

**Match Whole Word Only**
If checked, results only include whether the search string is matched as a discreet word in the file name. In addition to spaces, the following characters are used as breaking characters around a word "_-.()[] ". For instance, searching for "Test" with this option enabled would return files like "_Test.txt", "A(Test).jpg", "This is a Test.docx" and "file.test". But it would not return "testing.txt", "testimony.pdf" or "contest.zip".

This option is disabled by default. This option has no effect on wild-card searches.

**Search in Hash Set Database**
If checked, file matching current search setting will be check for in the specified Hash Set Database.

**Make Database Active**
If checked and Search in Hash Set Database is enabled, the currently selected database will be made active.

**Create Quick Hash Set...**
Create a quick hash set by specifying a list of hashes.

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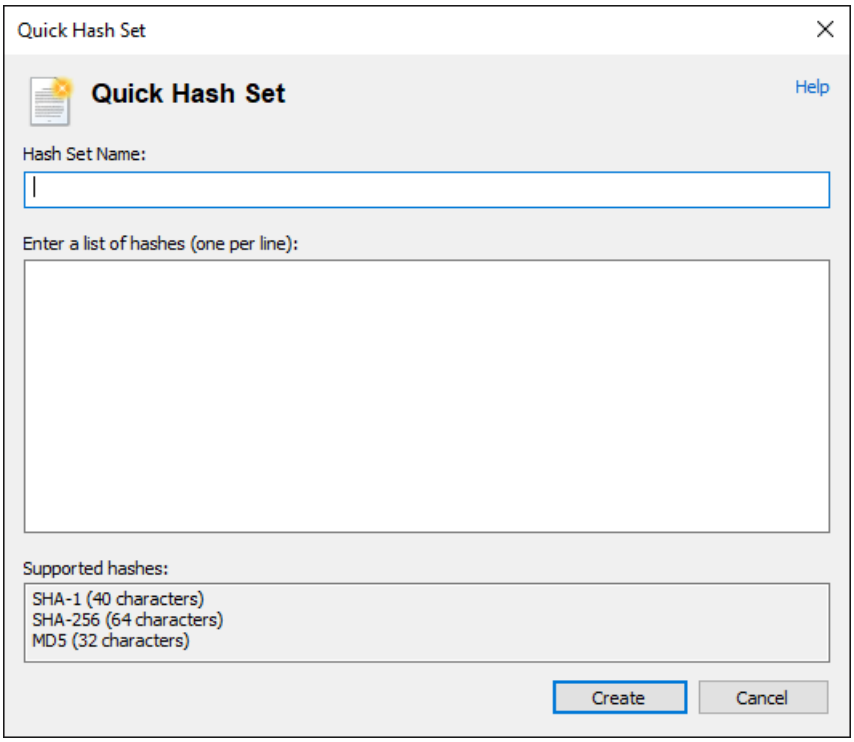


**Current Search Settings -** Settings that are applied to the current search preformed by File Name Search. Also allow creating and editing of Custom Presets.

**Preset**
Dropdown selection of the current preset being used. Default presets are loaded from a local text file and and user specified custom presets will be shown at the bottom of the list.

If *User-defined Search* is selected, the search string can be edited in the text box. Otherwise, a list of search strings and corresponding include/exclude folders are displayed in the list view. Search strings can be edited or deleted by right-clicking the item. Click 'Add' to add a new search string to the list.

**Delete**
Delete an existing preset. Default presets cannot be deleted using the configuration window. Edit FileNameSearchPresets.cfg file to remove default presets.

**Save**
Save the current settings to the currently selected preset. Default presets cannot be edited using the configuration window. Edit FileNameSearchPresets.cfg file to change default presets.

**Save As...**
Save the current settings under a new custom preset. You will be prompted to enter in a name for the new preset to be saved under. Custom Presets are stored in the OSForensics configuration file.

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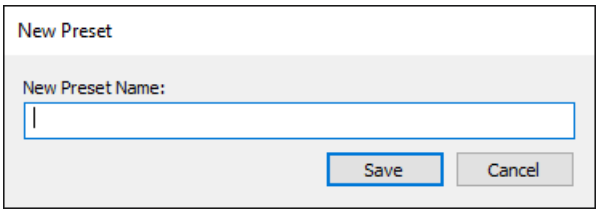


**File Size Limits**
Allows the user to specify file size limits for search results. The user may enter either a minimum, maximum, both or neither. The only restriction is that the maximum must be larger than the minimum.

**File Attributes**
Filters the search results based on the file system attributes that are checked.

**Archive**
A file or directory that is an archive file or directory, which is typically marked for the purpose of backup or removal.

**Compressed**
For a file, the data is compressed. For a directory, newly created files and subdirectories shall also be compressed.

**Encrypted**
For a file, the data is encrypted. For a directory, newly created files and subdirectories shall also be encrypted.

**Hidden**
A file or directory that is hidden, and are typically not shown in a directory listing.

**Read-only**
A file that cannot be written on or deleted. This attribute does not have any meaning for directories.

**System**
A file or directory that is used by the operating system.

**Reparse Point**
A file or directory that has a reparse point, which is typically used as a symbolic link.

**Sparse file**
A file that is a sparse file (eg. data is mostly zeros)

**Creation Date Range**
Allows the user to specify the creation date range for the search results.

**Modify Date Range**
Allows the user to specify the modify date range for the search results.

**Access Date Range**
Allows the user to specify the access date range for the search results.

**MFT Modify Date Range**
Allows the user to specify the MFT modify date range for the search results (if applicable).

**Gather Alternate Stream Info**

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Selecting this option will gather information about alternate NTFS data streams within a file. Turning this on will slow down the search slightly.

**Minimum number of alternate stream**
A file must have at least this many alternate data streams to be included.

**Minimum size of alternate streams**
The total combined size of all alternate data streams must be at least this much for the file to be included.

**Filter on EXIF Metadata**
Allows to search against the EXIF metadata of an image file. Turning this on will slow down the search slightly.
Exiv2 (V0.27.3) tool is used to obtain the image metadata.

* Note that image files larger than 50 MB will be skipped from searching and will not be displayed in the result.
Exiv2 utility has little support on Movie file formats. Check here to see the supported image formats.

**Use RegEx (Regular Expressions)**
Allows to use the regular expression search of EXIF metadata.
Some examples of regular expressions are provided below:

- **Photos taken with common digital cameras**
(Make)[\s]+(Ascii)[\s]+[\d]+[\s]+(Canon|Nikon|Sony|Olympus|Pentax|Fujifilm|Panasonic|Leica|Kodak|GoPro|Polaroid|Ricoh|Hasselblad|Casio)

- **Photos taken with Canon or Nikon camera**
(Make)[\s]+(Ascii)[\s]+[\d]+[\s]+(Canon|Nikon)

- **Photos taken with common camera lenses**
(Lens([\w]+|))[\s]+[\w]+[\s]+[\d]+[\s]+(Canon|Nikon|Sigma|Tamron|Yongnuo|Rokinon|Pentax|Sony|Fujifilm|Olympus|Panasonic|Leica|Samyang|Tokina|Zeiss|Laowa)

- **Photos taken with Sigma lens**
(Lens([\w]+|))[\s]+[\w]+[\s]+[\d]+[\s]+(Sigma)

- **Photos taken with a flash**
(Flash)[\s]+(Short)[\s]+(1)[\s]+(Yes|Fired)

For more forensics regular expression examples see here.

### 5.11.2 File Name Search Results View

The user may view the file name search results in one of several views.

## File Details View

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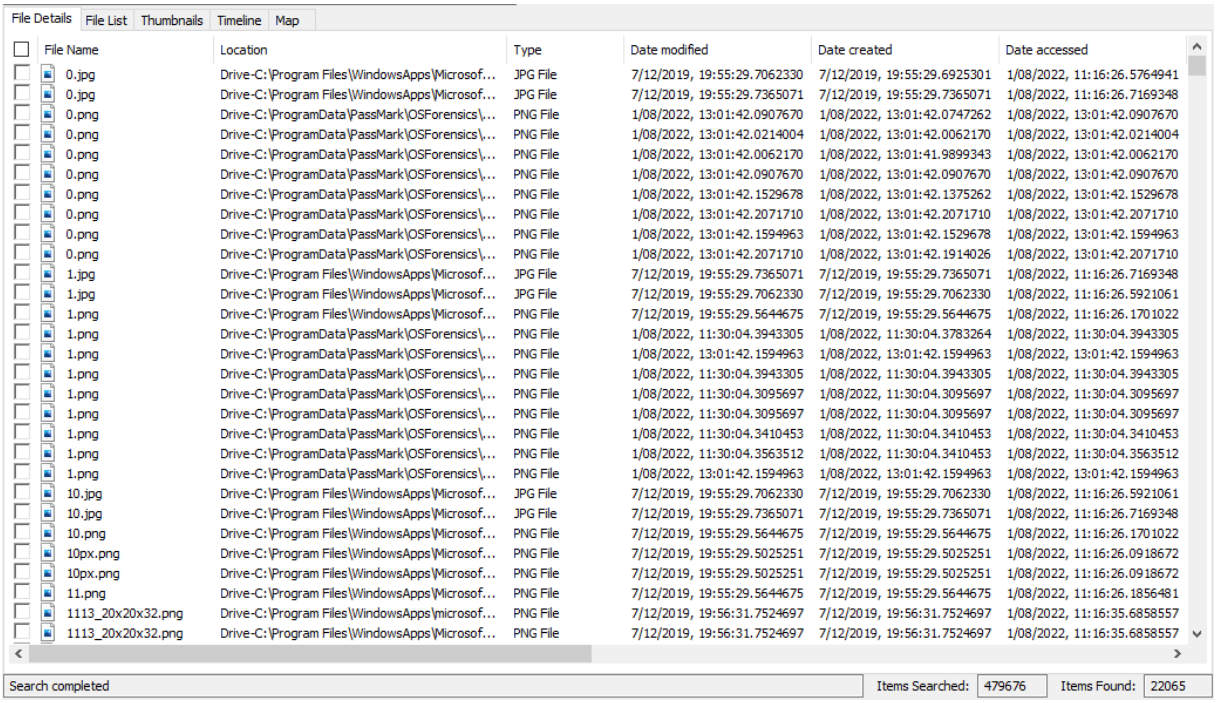
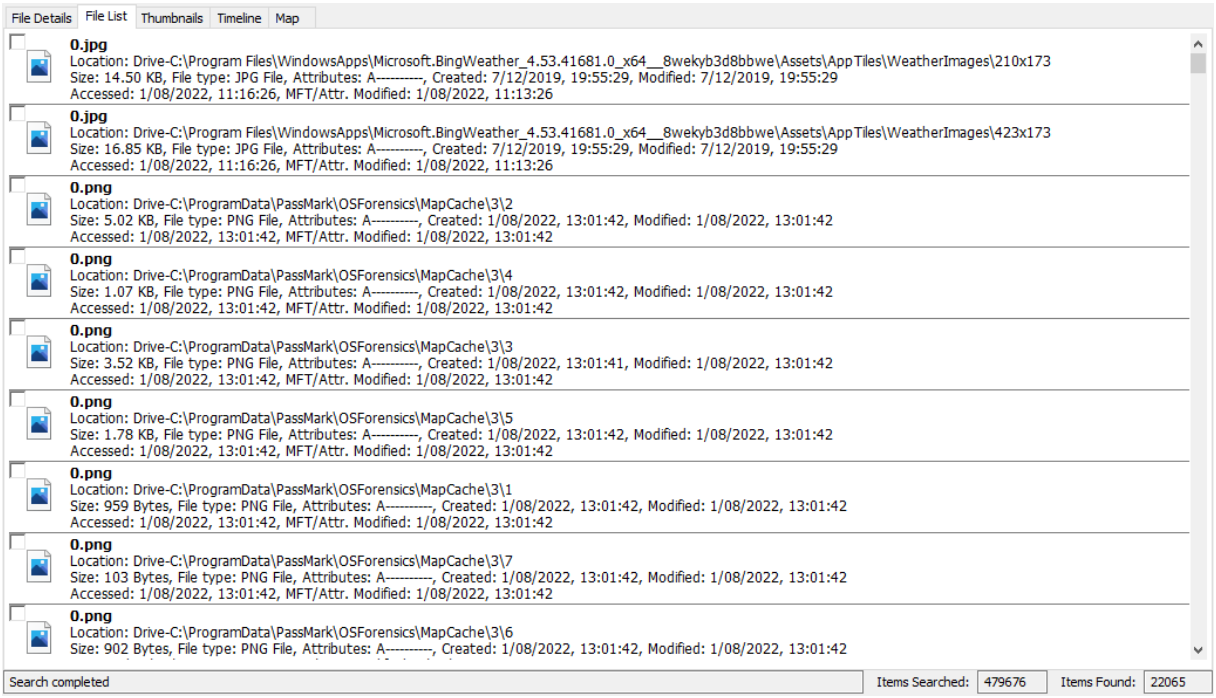



The File Details View displays the search result in a table format, listing the file names along with relevant attributes and metadata.

## File List View




The File List View displays the search result as a list of file names, along with the corresponding metadata and icon.

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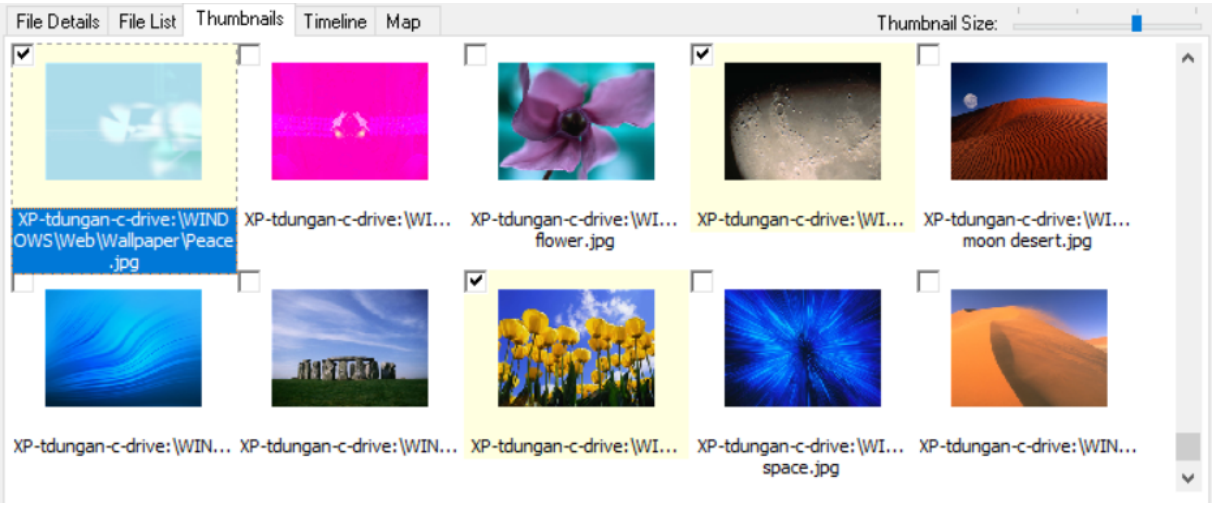
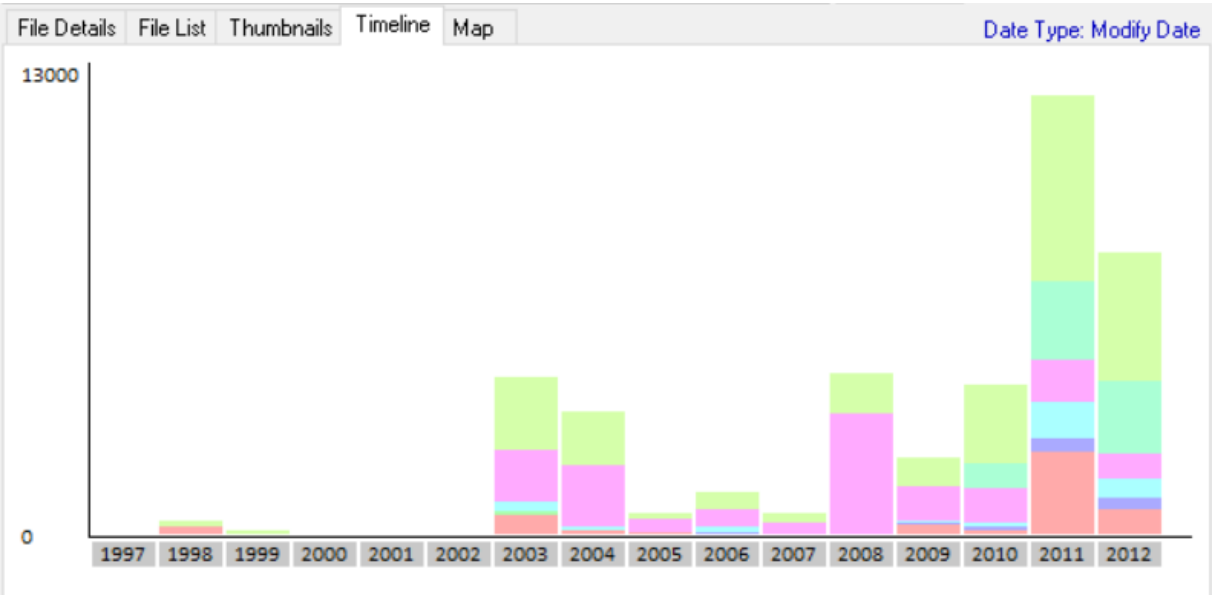
## Thumbnails View




The Thumbnails View displays the search result as a list of thumbnails as well as with its file path. This view is useful when searching for media files, allowing the user to quickly browse through the thumbnail images. The size of the thumbnails can be adjusted using the *Thumbnail Size* slider bar.

## Timeline View




The Timeline View displays an interactive bar graph providing the user with a visual view of the distribution of files with respect to the date of the files. This view is useful for identifying date ranges where significant file activity has occurred. The granularity of the scale can be adjusted by clicking on the bar graphs to zoom in or the '-' button on the top-right corner to zoom out. Each bar is colour-coded by file type. Right-clicking a bar section brings up the following menu:

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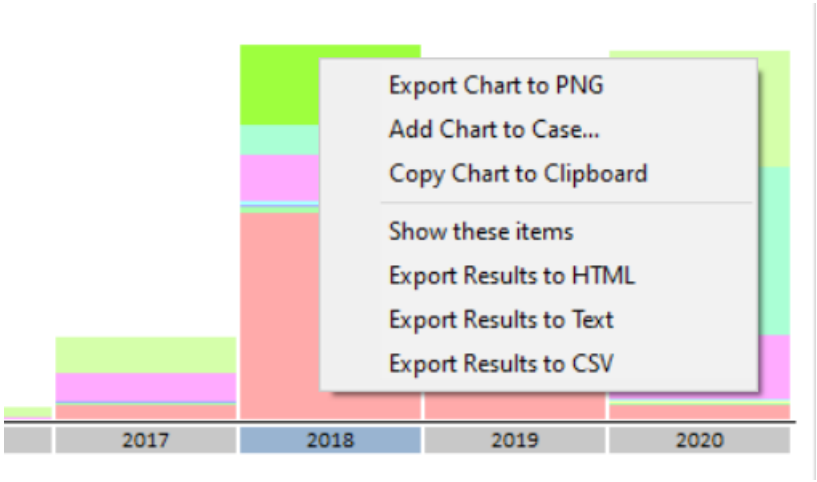


**Export Chart to PNG**
Export the chart as a PNG image file

**Add Chart to Case...**
Add the chart to the case as a PNG image file

**Copy Chart to Clipboard**
Copy the chart to the clipboard as a bitmap

**Show these files**
Filter the results to show only those that belong to the selected time bar

**Export to HTML**
Export the results contained in the highlighted bar to HTML

**Export to Text**
Export the results contained in the highlighted bar to text

**Export to CSV**
Export the results contained in the highlighted bar to CSV

## Map View

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The Map View plots files with GPS coordinates in EXIF metadata on a world map. This view is useful for visualizing geographic proximity of files with geotag information such as photos or videos. To change the zoom level, use the left slide bar or mouse wheel. To pan the world map, use the left directional arrows or mouse drag.

### 5.11.3 File Name Search Default Presets

The File Name Search module obtains the default list of preset searches from the `FileNameSearchPresets.cfg` file in the OSForensics program data folder (generally `C:\ProgramData\PassMark\OSForensics`).

Although the `FileNameSearchPresets.cfg` file can be modified, we do not recommend this as all changes will be lost each time the software is updated or installed. Instead, we strongly suggest using adding new presets through the configuration window. Doing this will result in your search presets being saved in the global OSF configuration file (a .OSFCfg file), which is preserved across updates.

## Modifying the Default Presets

The following is a snippet of the default `FileNameSearchPresets.cfg` file.

```
<?xml version="1.0" encoding="UTF-8" ?>
<FilenameSearchDefaultPresets>
  <Preset Desc="All Files">
    <FileSpec SearchString="*" />
  </Preset>
...
  <Preset Desc="E-mail Files">
    <FileSpec SearchString="*.pst;*.ost" />
    <FileSpec SearchString="*.dbx">
      <ExcludeFolder SubString="Dropbox" />
    </FileSpec>
    <FileSpec SearchString="*.idx">
      <IncludeFolder SubString="Outlook Express" />
    </FileSpec>
    <FileSpec SearchString="*.mbx;*.mbox" />
    <FileSpec SearchString="*.eml" />
    <FileSpec SearchString="*.dat">
      <IncludeFolder SubString="\\data\\3" />
    </FileSpec>
  </Preset>
...
</FilenameSearchDefaultPresets>
```

Each preset is defined using a `<Preset>` tag, with the `Desc` attribute specifying the name of the preset. In addition, the following optional attributes may be specified:

```
MinSize - Minimum file size in bytes
MaxSize - Maximum file size in bytes
Attributes - One or more of the following: ARCHIVE, COMPRESSED, ENCRYPTED, HIDDEN, READONLY, SYSTEM, RE
AltStreams - "True" to enable scanning alternate streams, otherwise "False"
MinAltStreams - Minimum number of alternate streams
MinAltStreamSize - Minimum size of alternate streams in bytes
FromCreateDate - Earliest file creation date in number of 100-nanosecond intervals since January 1, 160
ToCreateDate - Latest file creation date in number of 100-nanosecond intervals since January 1, 1601 (U
FromModifyDate - Earliest file modify date in number of 100-nanosecond intervals since January 1, 1601
ToModifyDate - Latest file modify date in number of 100-nanosecond intervals since January 1, 1601 (UTC
FromAccessDate - Earliest file access date in number of 100-nanosecond intervals since January 1, 1601
ToAccessDate - Latest file access  date in number of 100-nanosecond intervals since January 1, 1601 (UT
FromExtraDate - Earliest file extra date in number of 100-nanosecond intervals since January 1, 1601 (U
ToExtraDate - Latest file extra date in number of 100-nanosecond intervals since January 1, 1601 (UTC)
SortCriteria - The sort criteria to use to order the results
FilterOnEXIF - "True" to enable searching EXIF metadata
EXIFSearchString - Search keyword (string or pattern) for EXIF metadata search
UseRegExp - "True" to enable regular expression pattern matching
```

A `<Preset>` tag contains an array of `<FileSpec>` tags, which define a search string (`SearchString` attribute) along with folder to include (`<IncludeFolder>`) and exclude (`<ExcludeFolder>`) for the corresponding search string.

If the file matches any of the `<FileSpec>` definitions, it shall be included in the results.

In the following example, any file names that match `"*.idx"` where the folder includes the string `"Outlook Express"` shall be included in the results.

```
    <FileSpec SearchString="*.idx">
      <IncludeFolder SubString="Outlook Express" />
    </FileSpec>
```

In this example, any file names that match `"*.dbx"` where the folder **does not** include the string `"Dropbox"` or `"Dont_look_here"` shall be included in the results.

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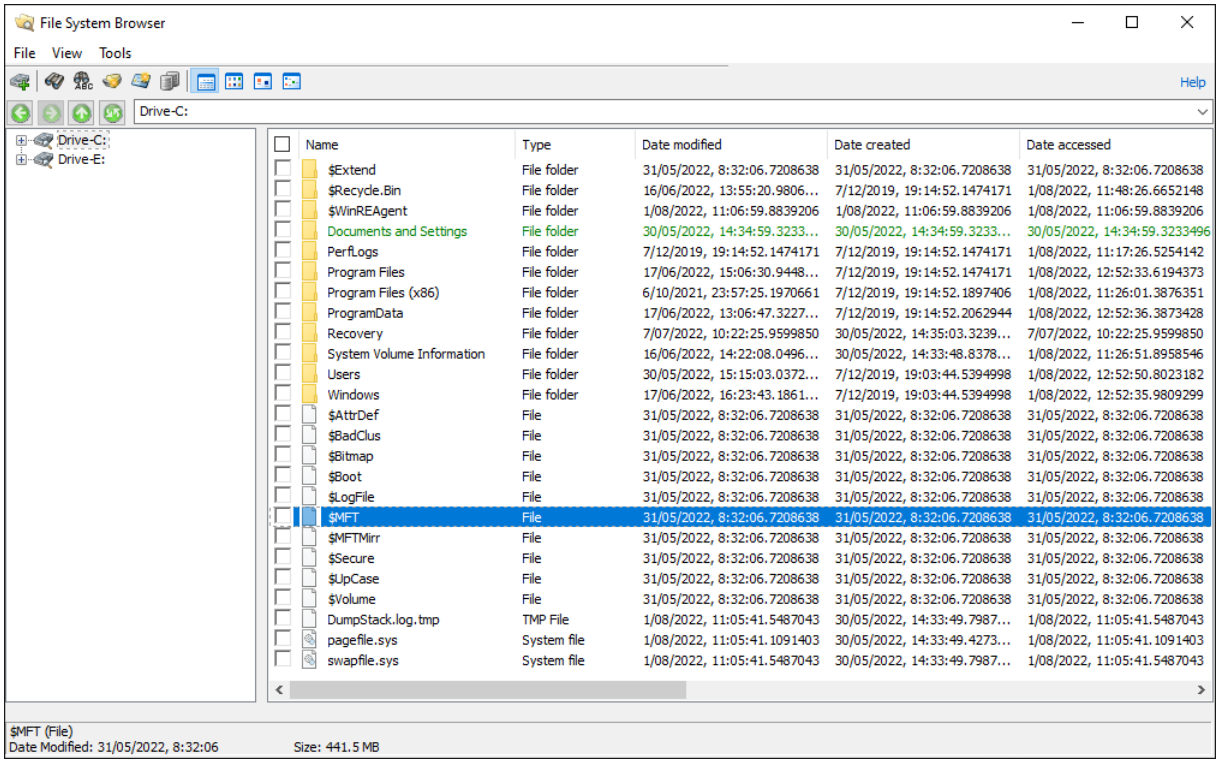
```
<FileSpec SearchString="*.dbx">
  <ExcludeFolder SubString="Dropbox" />
  <ExcludeFolder SubString="Dont_look_here" />
</FileSpec>
```

## 5.12 File System Browser

The File System Browser provides an explorer-like view of all devices that have been added to the case. Unlike Windows Explorer, the File System Browser is able to display additional forensic-specific information, as well as allow analysis to be performed using OSForensics' integrated tools.




**OSForensics File System Browser**

The left pane provides a hierarchical view of all devices added to the case. Clicking on a node shall load its contents into the right pane.

## Understanding the File System Browser

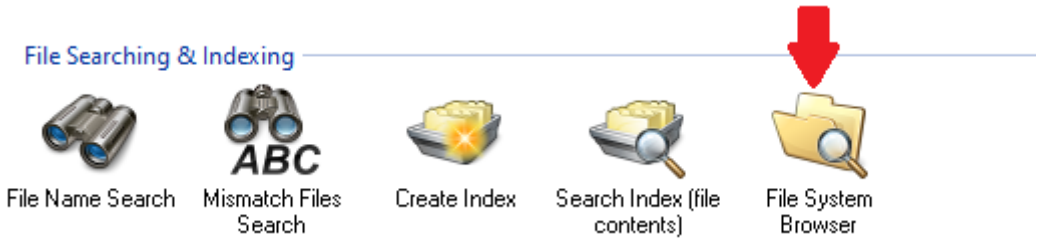
The table below summarizes the main components of the File System Browser.

| Component | Description |
|---|---|
| Hierarchical View | Tree organization of all devices added to the case |
| File List | List view of the file entries contained in the current path. User may choose from several |

| | |
|---|---|
| | views.<br><br>Red text - Deleted files<br>Green text - Reparse points<br>Blue text - Deleted file entries found in $I30 slack space<br>Gray text - Shadow copy of the file |
| Metadata Columns | (Details view only) Contains metadata information for each file entry in the list |
| Navigation Bar | Shows the current path. Entering a new path shall navigate to the specified location. |
| Navigation Buttons | Navigate to the previous/parent path, or refresh the current path |

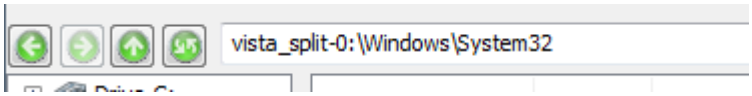
## Opening the File System Browser

The File System Browser is accessible via the "File System Browser" icon in the "File Searching & Indexing" group under the Start tab, as well as the right-side navigation "File System Browser" button. Once opened, all devices added to the case are listed in the left hierarchical view.



## Usage

## Navigation Bar/Buttons



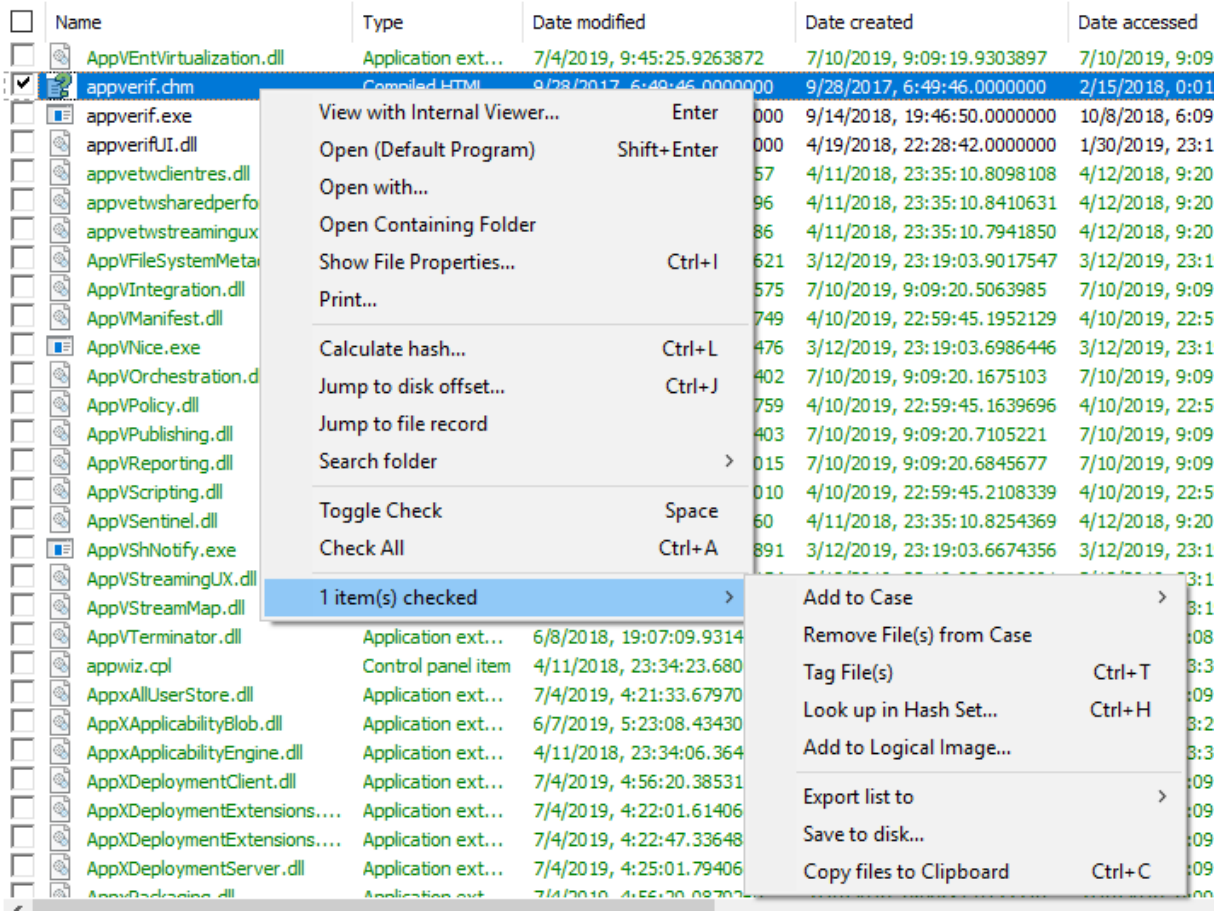

The navigation bar shows the current path that is being displayed in the File List view. The current path can be changed by typing the new path into the navigation bar.

To navigate to the previous or parent path, use the Back/Forward/Up buttons. To refresh the current path, use the Refresh button.

## Right-click Menu

The right-click menu allows the user to perform forensic analysis on the file entries using OSForensics' integrated tools.

### *File List Menu*




**View with Interval Viewer...**
Opens the file with OSForensics Viewer to perform a more thorough analysis. *Keyboard shortcut: Enter*

**Open (Default Program)**

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Opens the file with the default program. *Keyboard shortcut: Shift+Enter*

**Open With...**
Allows the user to select the program to open the file

**Open Containing Folder**
Opens the folder than contains the file

**Show File Properties...**
Opens the file with OSForensics Viewer in File Info mode. *Keyboard shortcut: Ctrl+I*

**Print...**
Print the file (if applicable)

**Calculate Hash...**
Opens the Verify/Create Hash tab with the file path set to the selected file. *Keyboard shortcut: Ctrl+L*

**Jump to disk offset...**
Opens the Raw Disk Viewer tab and jumps to the disk offset of the selected file. *Keyboard shortcut: Ctrl+J*

**Toggle Check**
Toggle the check state of the selected item.

**Check All**
Check all the items in the list.

**n Item(s) checked**

**Add to Case**
Add the checked file(s) or list of checked file(s) to the case

**Remove File(s) from Case**
Remove the checked file(s) from the case

**Tag File(s)**
Tag file(s) for future reference. *Keyboard shortcut: Ctrl+T*

**Look up in Hash Set**
Verify whether the checked file(s) and files contained in selected folder(s) are in a hash set in the active database. See Hash Set Lookup. *Keyboard shortcut: Ctrl+H*

**Add to Logical Image...**
Add the selected file(s) to the list of Source Paths in the Forensic Imaging module in preparation for creating a logical image.

**Export list to**
Export the list of checked file(s) to a TXT, CSV or HTML file

**Save to disk...**
Save the checked file(s) to a location on disk.

**Copy File(s) to Clipboard**

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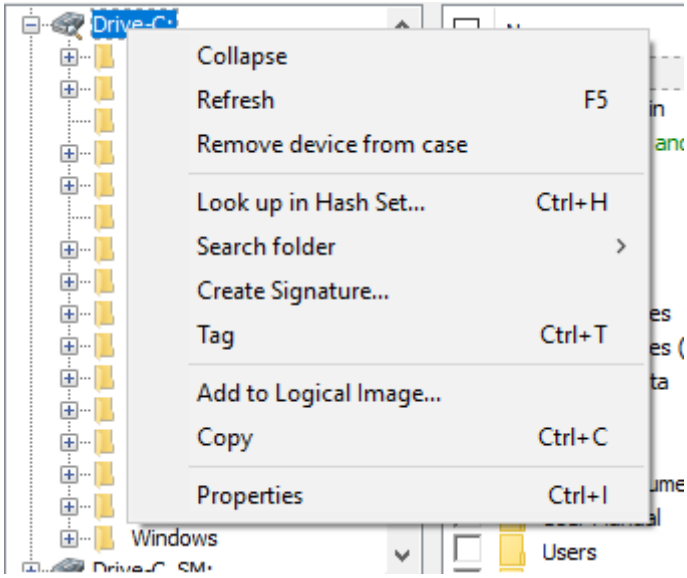
Copy the checked file(s) to clipboard. Once copied to the clipboard, the file(s) can be pasted to any other application that supports it (eg. Windows Explorer).

*Note: In some cases, copy and pasting files to an explorer window may fail without an error message when "preparing to copy". This may happen if the file has already been deleted (eg a temp file) or if Windows Explorer does not have permissions to access the files (eg restricted system files and folders). In these cases, it is better to use the "Add to case" function.*

### *Hierarchical View Menu*




**Expand/Collapse**
Expand/collapse the selected folder

**Refresh**
Refresh the contents of the selected folder in the Object List pane. *Keyboard shortcut: F5*

**Remove device from case**
Remove the selected device from case *(Devices only)*

**Look up in Hash Set...**
Recursively determine whether the contents of the selected folder is contained in a hash set in the active database. See Hash Set Lookup. *Keyboard shortcut: Ctrl+H*

**Search folder**

**File Name Search...**
Opens the File Name Search tab with the file path set to the selected folder path. *Keyboard shortcut: Ctrl+F*

**Mismatch File Search...**
Opens the Mismatch File Search tab with the file path set to the selected folder path. *Keyboard shortcut: Ctrl+M*

**Search folder**

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Opens the Create Signature tab with the file path set to the selected folder path.

**Tag**
Tag path for future reference. *Keyboard shortcut: Ctrl+T*

**Add to Logical Image...**
Add the selected folder to the list of Source Paths in the Forensic Imaging module in preparation for creating a logical image.

**Copy**
Copies the selected folder to the clipboard. *Keyboard shortcut: Ctrl+C*

### Advanced Options

The File System Browser includes several advanced options that can be accessed under Tools->Options...

**Calculate Folder Sizes**
When enabled, the total size of all contained files/folders are calculated

**Shadow Copies**
When enabled, previous shadow copies of files are shown alongside current files

**Deleted Files**
When enabled, deleted file entries contained in the current path are displayed.

## 5.12.1 File Metadata

The following is a description of the File System Browser columns in Details view:

**Name**
The name of the item (eg. file/directory)

**Type**
A short description of the item (eg. file type)

**Date modified**
The date the item was last modified

**Date created**
The date the item was first created

**Date accessed**
The date the item was last accessed

**MFT/Attribute Modify Date** *(for supported file systems only)*
The date the file system record for this item was last modified

**Size**
The size of the item (eg. file size)

**Size on Disk**
The size allocated to the item on disk storage.

For normal files, this is a multiple of the cluster size.

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For NTFS files resident in the MFT, this is the same as the file size

For NTFS compressed/sparse files, this is the amount of physical disk space allocated to the file (usually smaller than the file size)

**Attributes**
The attributes of the item (eg. file attributes). Attributes are represented as single characters if present (eg. 'A') or a hyphen (eg. '-') if not present.

ACDEHRrsSdLU

*A - Archived*
*C - Compressed*
*D - Directory*
*E - Encrypted*
*H - Hidden*
*R - Read-only*
*r - Reparse Point*
*s - Sparse file*
*S - System file*
*d - Deleted file*
*L - Symbolic link*
*U - Partially initialized file (ie. only part of the file is valid; the remaining part may contain remnants from a file it was previously allocated to)*

**# Streams**
The number of alternative streams contained in the file, if applicable. This value does not include the default stream.

**Total stream size**
The total size of alternative streams contained in the file, if applicable. This value does not include the default stream.

**# Fragments**
The number of fragments of consecutive allocation units that the file is divided into.

**Clusters/Fragments**
The average number of clusters per fragment of the file

**Starting LCN**
The cluster number of the first cluster of the file

**Flags**
The flags assigned to the item by OSForensics. Each flag is represented by a single character if present (eg. 'H'), or a hyphen (eg. '-') if not present.

HTCV

*H|N - in Hash set/Not in hash set*
*T - Item is tagged*
*C - Item was added to the Case*
*V - Item was Viewed in the internal viewer*

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**Category**
The category of the item if it has been added to the case.

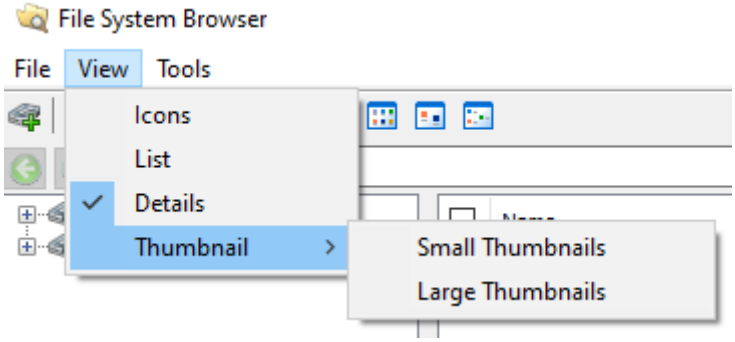
### 5.12.2 File Browser Views

The user can choose from one of the following views in the File System Browser:

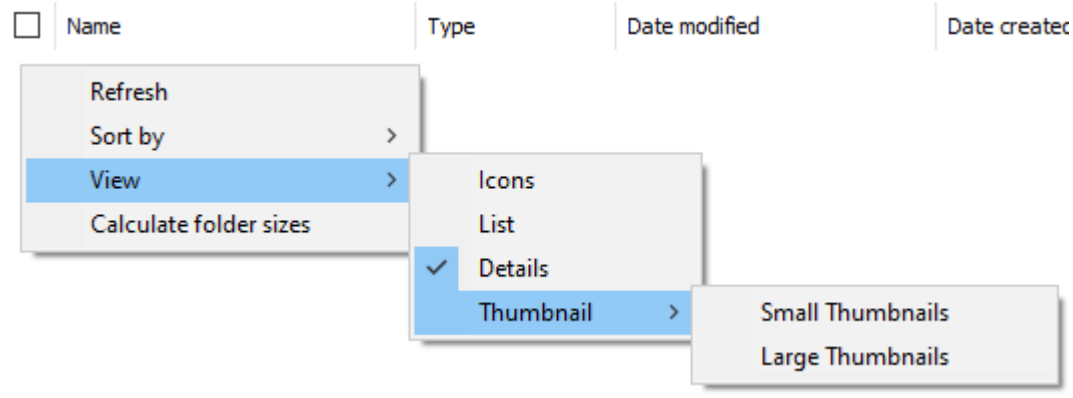
- Icon view
- List view
- Details view
- Small Thumbnails view
- Large Thumbnails view

The view can be changed via the toolbar icon,

under 'View' in the system menu,




or right-click context menu.




## Icon View

Icon view displays the object's name and associated icon.

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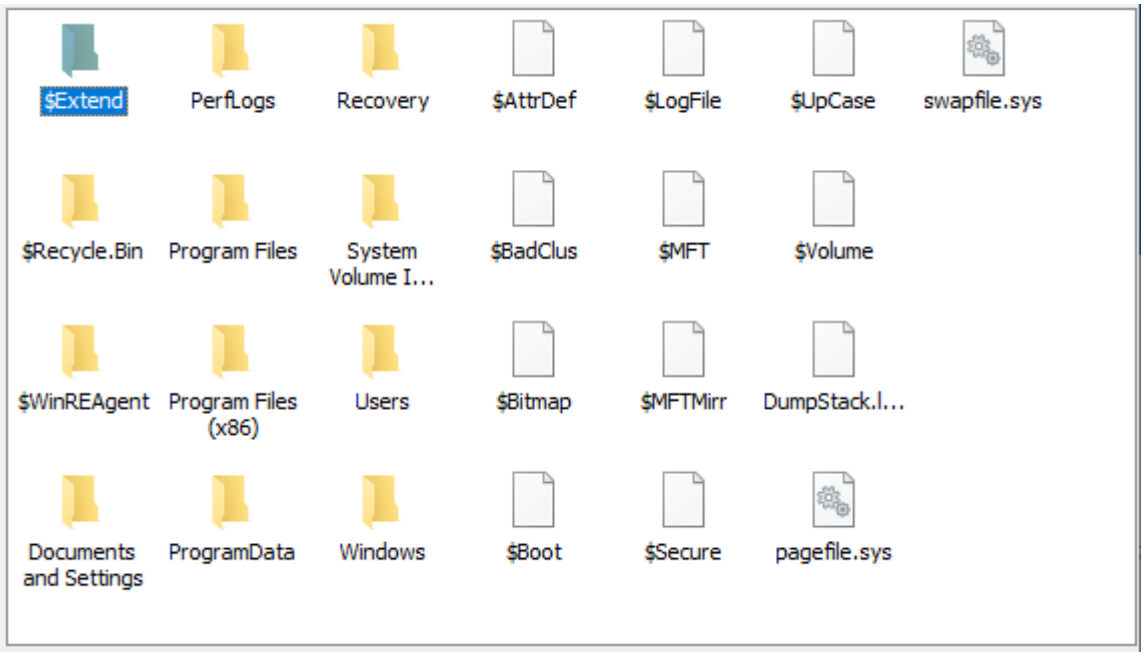
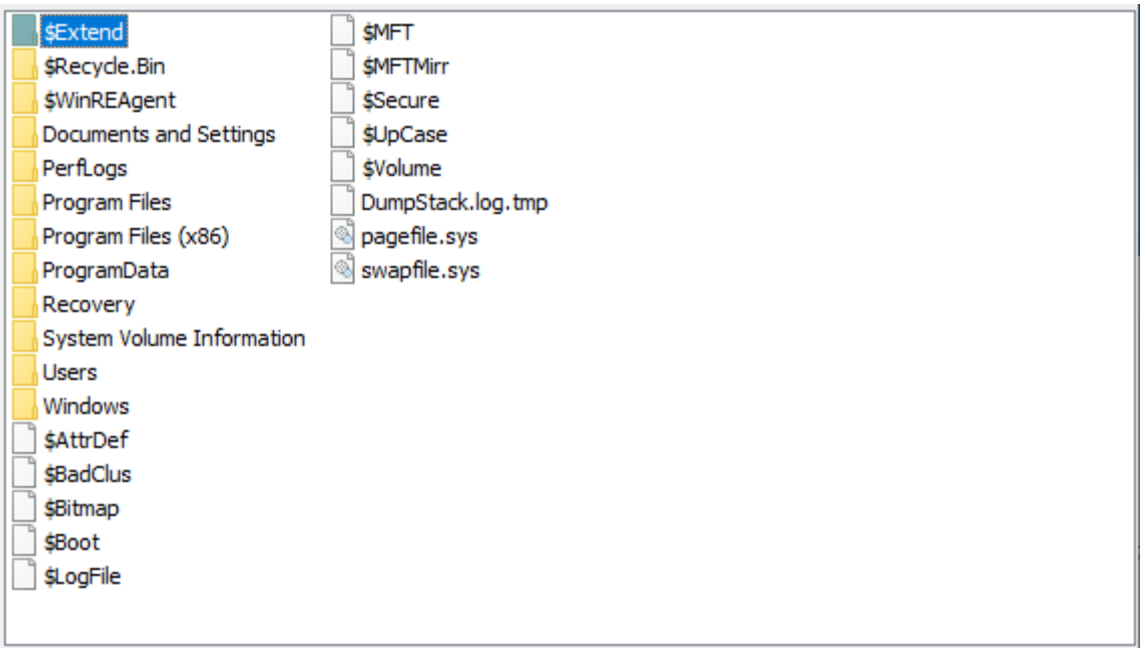



## List View

List view displays the object's name and associated icon in a compact fashion.




## Details View

Details view displays the metadata associated with the object.

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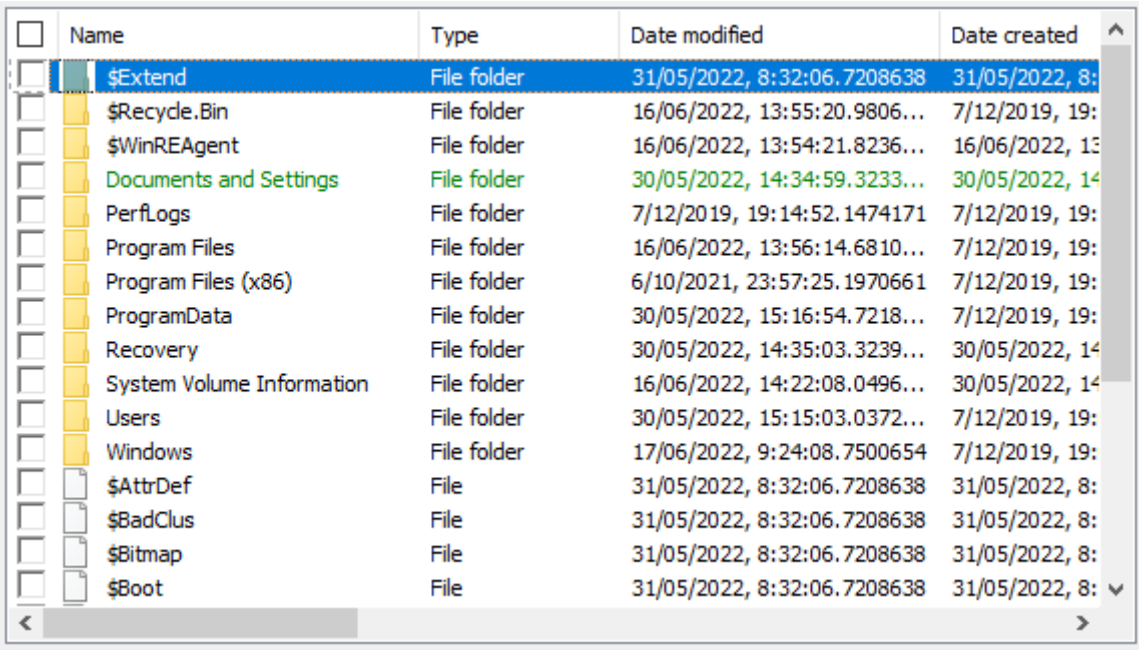
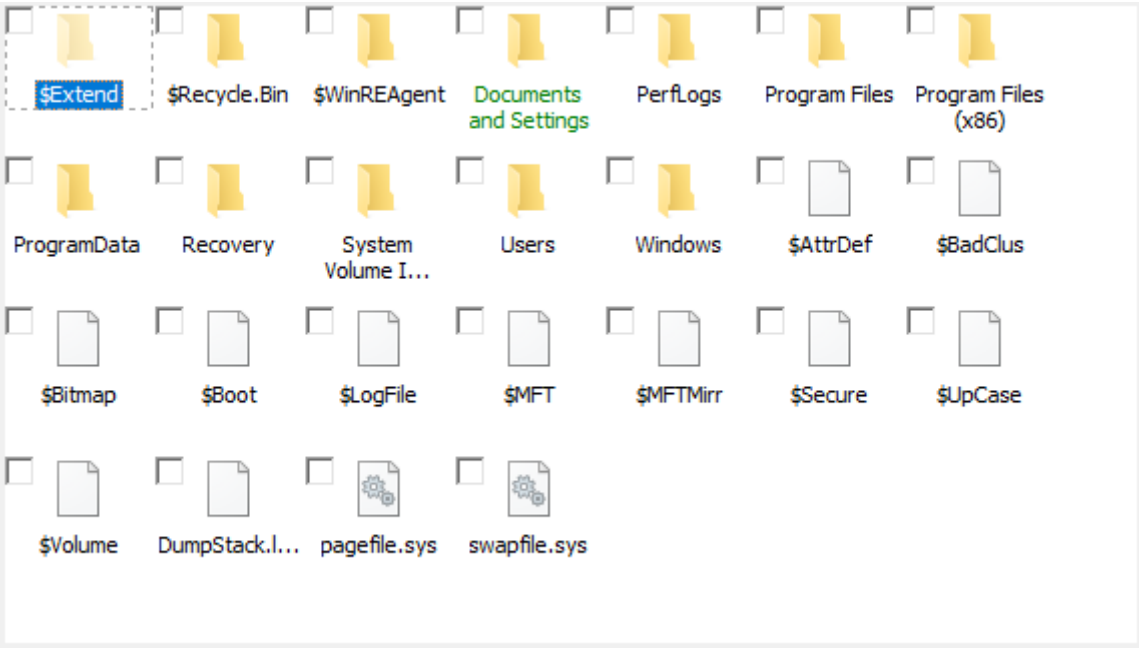



## Small Thumbnails View

Small Thumbnails view is similar to Icon view, but a small thumbnail is displayed for image files.




## Large Thumbnails View

Large Thumbnails view is similar to Icon view, but a large thumbnail is displayed for image files.
.

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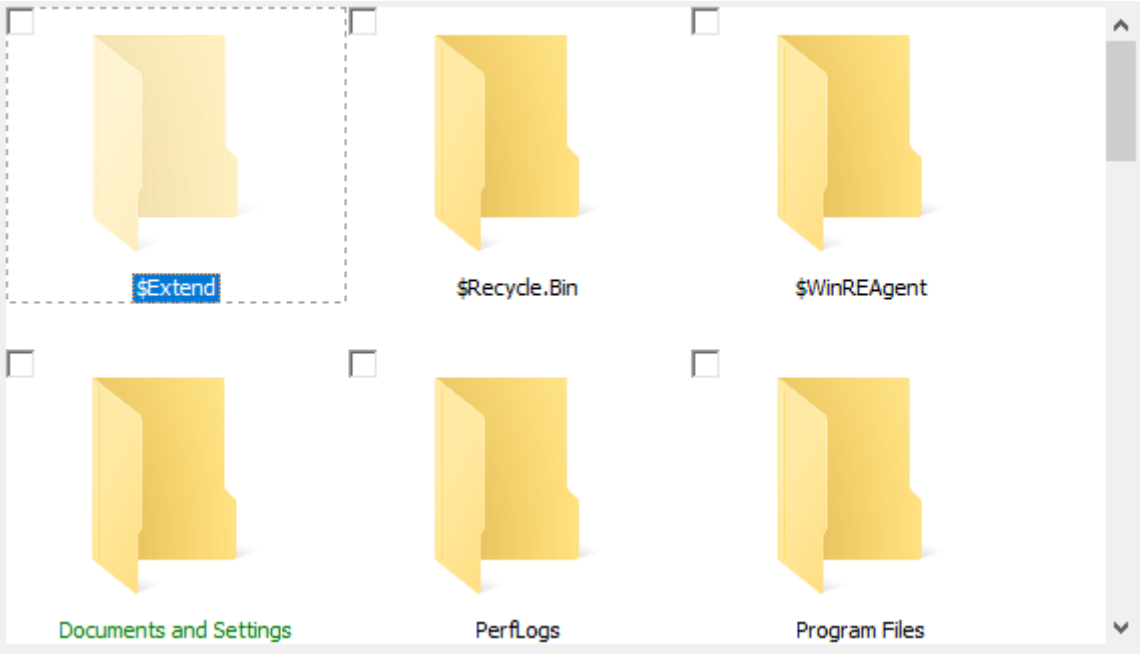


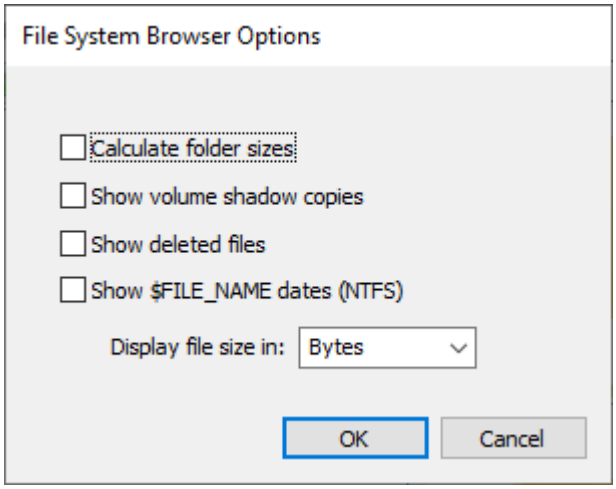

### 5.12.3 Shadow Copies

Previous shadow copies can be shown alongside current files within the File System Browser. Shadow copies are supported for certain devices that have been added to case. Supported devices are:

- Drive in Forensic Mode
- Physical Disks
- Volume Images

## Enabling shadow copies in File System Browser

1. Add the supported device(s) to the current case.
2. Add the shadow copies for the volume added in step 1.
3. From the File System Browser window, select the "Tools->Options..." menu. Check the 'Show volume shadow copies" check box.

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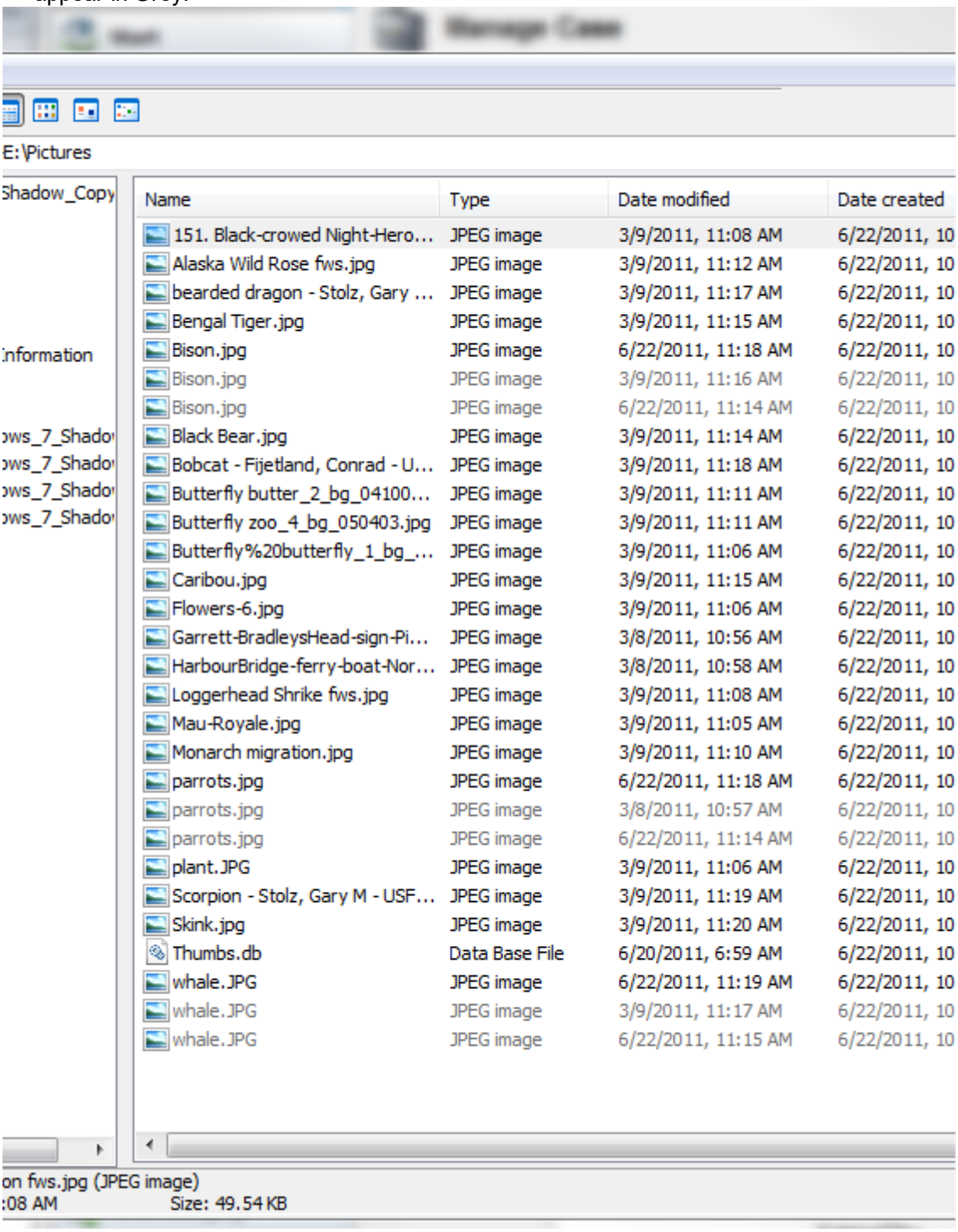
4. From the File System Browser window, select the "Tools->Options..." menu. heck the 'Show volume shadow copies" check box.
5. Shadow copies of files will now appear along side the current files. A file will be consider a previous copy if the modified date differs from the current copy and other Shadow copies.Shadow copies will appear in Grey.




6. A new meta data column will be added to the end to indicate in which Volume Shadow Copy the file is from.

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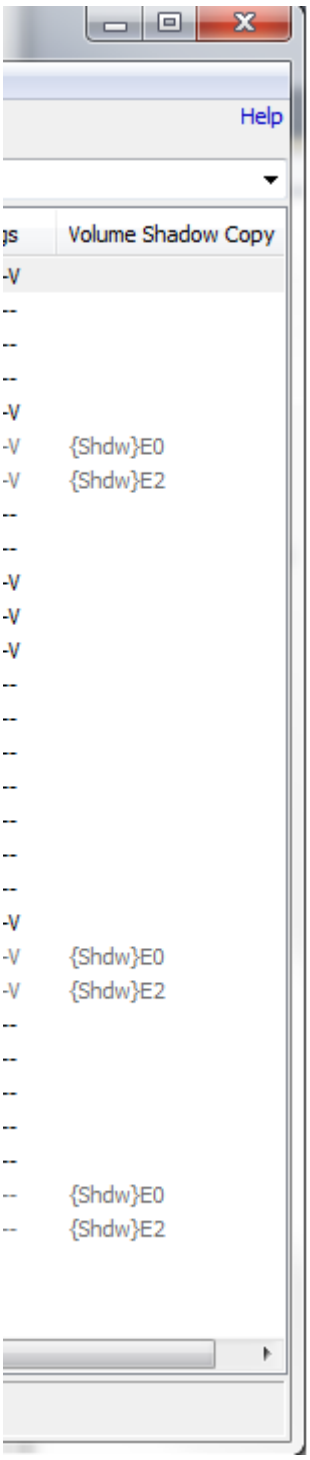


### 5.12.4 Deleted Files

When enabled, the File System Browser is capable of displaying a list of deleted files in the current directory. Deleted file entries are displayed in red text, with a small, red 'X' overlaying its icon.

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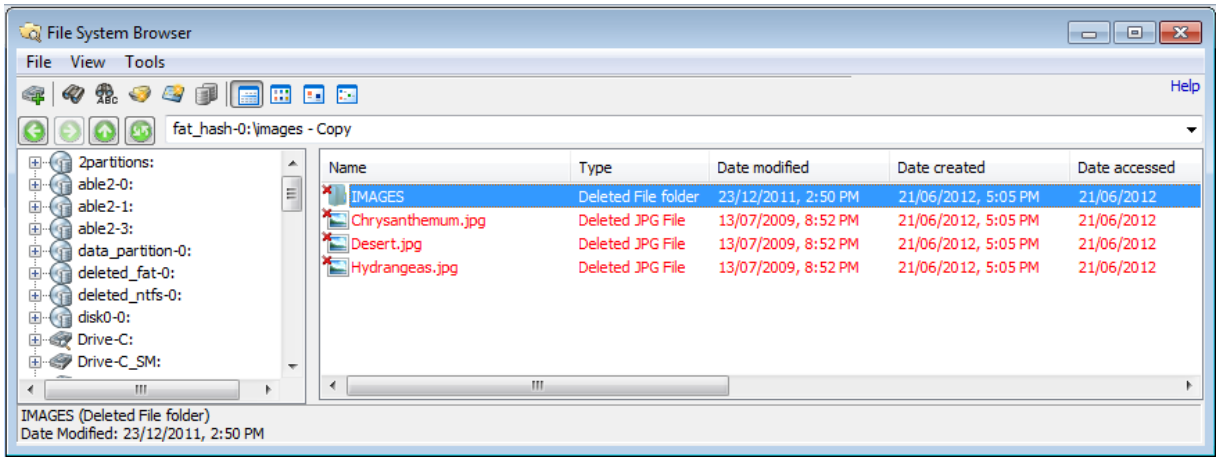
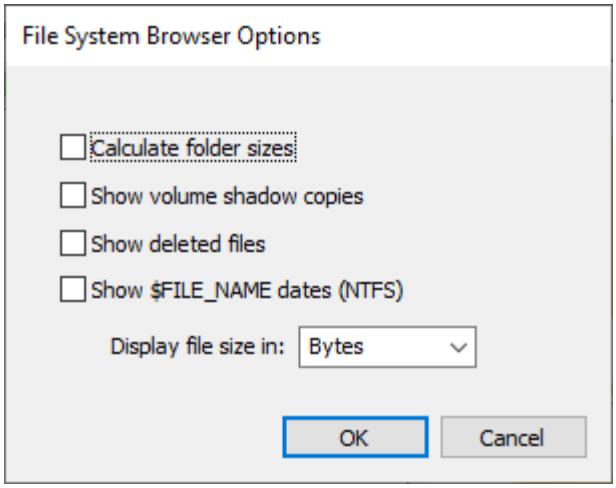



## Enabling deleted files in File System Browser

From the File System Browser window, select the "Tools->Options..." menu. Check the 'Show deleted files" check box.




*Note: Enabling deleted files will cause the file entries to take longer to load.*

# 5.13 Forensic and Cloud Imaging

The disk imaging functionality allows the investigator to create and restore disk image files, which are bit-by-bit copies of a partition, physical disk or volume. Disk imaging is essential in securing an exact copy of a storage device, so it can be used for forensics analysis without risking the integrity of the original data. Conversely, an image file can be restored back to a disk on the system.

A forensics investigator may need to deal with physical disks that are part of a RAID configuration. Without having access to the RAID controller needed to recreate the RAID array, it may be difficult to reconstruct the logical disk for forensics analysis. Given a set of disk images, OSForensics can rebuild the logical image based on the specified RAID parameters. RAID parameters from software RAID created under Linux and Windows can be automatically detected.

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A hard disk may also contain hidden areas that are normally inaccessible to users, namely Host Protected Area (HPA) and Device Configuration Overlay (DCO). The disk imaging module can detect for the presence of an HPA and/or DCO, and optionally create images of these hidden areas.

### Create Image
Module that performs imaging on any disk attached to the system

### Restore Image
Module that restores images to any disk attached to the system

### Hidden Areas - HPA/DCO
Module that detects for the presence of HPA and DCO hidden areas on a disk. If present, these areas can be imaged or removed.

### RAID Rebuild
Module that can rebuild a RAID array from a set of disk images and specified RAID parameters.

### Create Logical Image
Module that creates a logical image that includes only the files/directories specified by the user and contents from supported Cloud Drive services.

### Create Logical Android Image
Module that creates a logical Android image from an Android device using adb.exe.

## 5.13.1 Create Image

OSForensics allows the user to take exact copies of partitions, disks and volumes of an active system, or any device added to the case. This is particularly useful for live acquisitions while running OSForensics from USB. However, if you want to make a copy of a drive from a non live system, see OSFClone.

Creating a disk image makes use of the Volume Shadow Copy service built in to Windows. This allows OSForensics to make copies of drives that are in use without resulting in data corruption from reading files that are currently being written to. This is especially important for imaging system drives which Windows is constantly modifying. Once a shadow copy has started, a snapshot state of the drive is frozen at that point in time, so even if important evidence is being removed by another process in the background it will still appear in the resulting image file.

If the shadow copy service is not available, OSForensics tries to lock the drive to prevent any other programs from writing to it. If this is not possible, a warning will appear. Drives copied without a shadow volume or a lock are prone to creating corrupt images on completion.

Once the drive image has been created it can later be analyzed by adding it to the case or mounting it with OSFMount.

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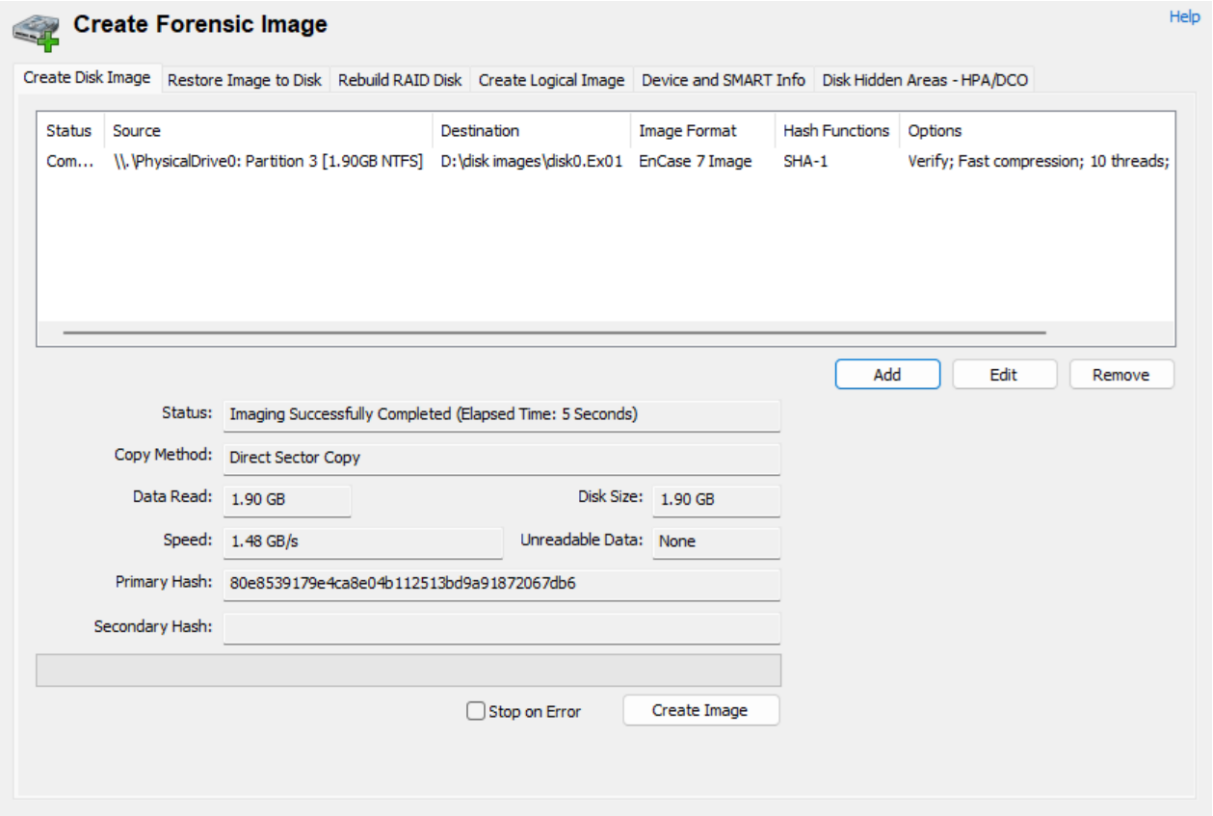


**Status**
The current status of the imaging process. Also shows a duration where available. Note that the duration is only for that particular step or the process.

**Copy Method**
The method being used to create the disk image (either a shadow copy or a direct sector copy). Also whether OSF managed to lock the volume or not.

**Data Read**
The amount of data that has currently be read from the source disk.

**Disk Size**
The size of the source disk.

**Speed**
The current imaging speed. For E01/Ex01 images with compression enabled, the compression speed is also displayed.

**Unreadable Data**
If a sector was unreadable, it will fill that sector with 0's and continue on. This field lets you know how much data was unreadable, due to restricted access or a damaged disk.

**Primary Hash/Secondary Hash**
If enabled, the hash value calculated from the data of the source disk using the selected hash algorithm.

## Adding Source Disk to Image

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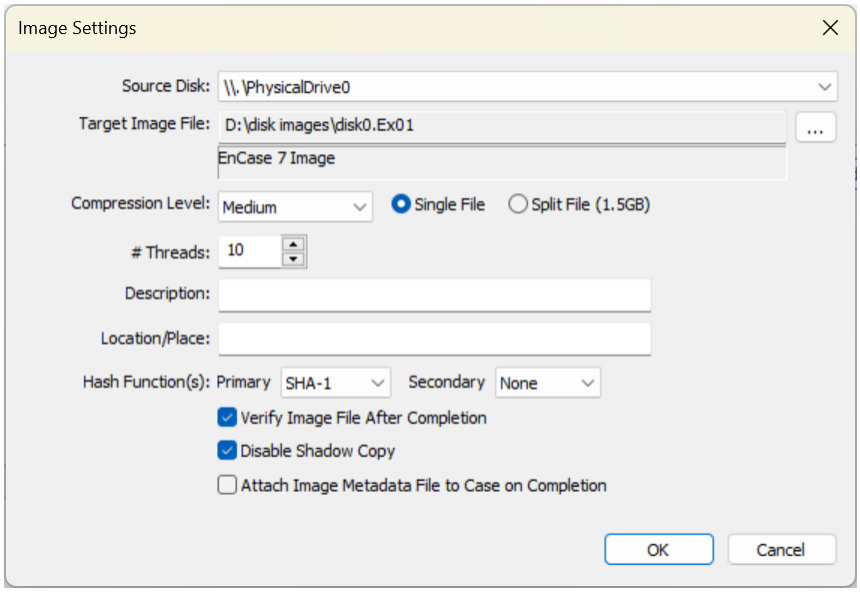
To add source disk(s) to image, click the *Add* button to view the following dialog.




**Source Disk**
The partition, disk, volume or device to create an image of. Note that only partitions with drive letters can be shadow copied.

**Target Image File**
The location to save the image file to. An .info file with the same name will also be created at this location. After specifying the image file path to save to, the image file format shall be displayed below depending on the file extension used.

**Compression Level** *(for E01, Ex01, AFF and AFD images)*
If the image file format supports compression, one of the following level of compression of the image file can be specified: *None*, *Medium* (default), or *Highest* (slowest).

*Note that imaging disks that have many empty sectors is much faster than disks with data as there is special handling of sectors which are all zeros. As such, the imaging speeds may significantly vary during the imaging process. Imaging of data that is already compressed (or very random) is slower than data that have higher compressibility.*

**Single File** *(for E01 and Ex01 images)*
If selected, a image shall be stored in a single file.

**Split File (1.5GB)** *(for E01 and Ex01 images)*
If selected, the image shall be split into 1.5GB segment files.

**# Threads** *(for E01 and Ex01 images)*
The number of threads to use for compression. By default, this is set to the number of physical CPU threads subtracted by 2 (and must be at least 3). The maximum number of threads is 32.

*In general, the imaging speed increases as more threads are used, up to a certain saturation point where there is no noticeable increase in performance. This is because at this point the RAM bandwidth becomes the bottle neck during the compression process. So in additional to having fast SSD drives, having fast RAM and at least a 4 Core CPU can help with imaging speeds.*

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**Description**
A simple description of the image that will be stored in the accompanying .info file.

**Location / Place**
A description of where the disk was obtained. This will be stored in the info file.

**Hash Function / Secondary Hash Function**
Specify the hash function to use for hashing. A secondary hash function can also be specified to calculate the hash value simultaneously.
In some cases this will slow down the imaging time as it can be slower to calculate a hash value than read or write to the disk however the speed will be different for each hash type and is very hardware dependent.

In order of speed we recommend;
- No hashing if speed is more important than being able to verify the image later
- SHA-1 on newer CPUs that support SHA instructions (AMD Zen 2017 and later, Intel Ice Lake 2019 and later)
- CRC32-C on older CPUs where an ability to verify the image is required (CPUs with SSE 4.1 support)
- MD5 on older CPUs where a more robust check of the image is required

**Verify Image File After Completion**
Check this to verify the image file hash against the source disk hash. This can take as long as the initial imaging, thereby doubling the time for the entire process.

**Disable Shadow Copy**
The imaging process will not attempt to use the windows Volume Shadow Service to perform the copy.

**Attach Image Metadata File to Case on Completion**
Upon imaging process completion, prompt the user to attach the image validation file (.info.txt) to case.

### 5.13.2 Restore Image

Restoring an image to a disk returns the disk contents back to a previous state, allowing an investigator to observe the changes that occur on the disk while being attached to the live system. This may be useful if an investigator wishes to boot an image of a system disk on a live machine in order view the state of system from the user's perspective.

OSForensics can only restore an image file if a lock to the disk is obtained. This is to prevent any other programs from writing to the disk while the restoration is in progress. For OSForensics to successfully obtain a lock, no programs can be accessing the disk at the time (eg. files on the disk being opened).

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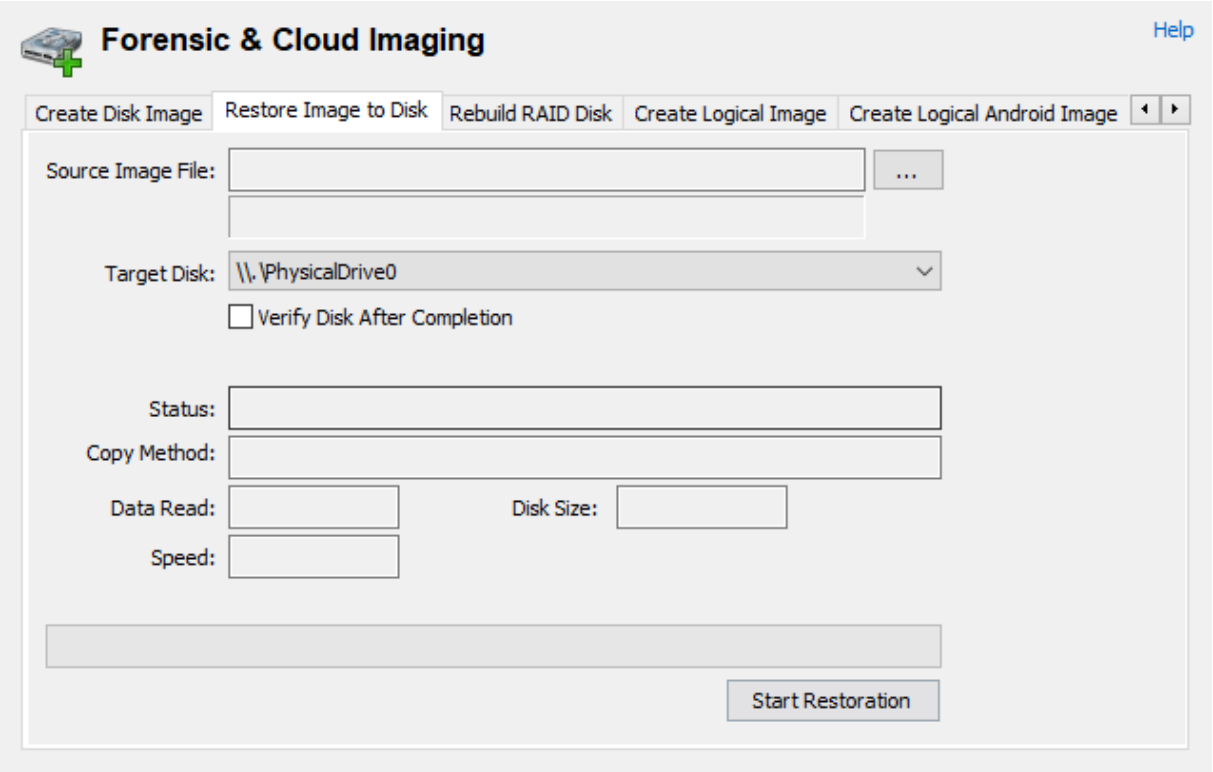


**Source Image File**
The image file containing the disk contents to restore the disk to.

**Target Disk**
The disk to write the contents of the image file to.

**Verify Disk After Completion**
Check this to verify the target disk hash with the source image file hash. This can take as long as the restoring process, thereby doubling the time for the entire process.

**Status**
The current status of the restoring process. Also shows a duration where available. Note that the duration is only for that particular step or the process.

**Copy Method**
The method being used to restore the disk image. This will always be 'Direct Sector Copy'.

### 5.13.3 Hidden Areas - HPA/DCO

The Host Protected Area (HPA) and Device Configuration Overlay (DCO) are features for hiding sectors of a hard disk from being accessible to the end user.

A typical usage for an HPA is to store boot sector code or diagnostic utilities of the manufacturer. However, the HPA can also be used for malicious intent including hiding illegal data, which may be of interest to forensics investigators.

The DCO feature was proposed to allow system vendors to purchase hard disks of different sizes, but setting the hard disk capacity of each disk to the same size. Again, the hidden sectors can be used for hiding data of forensic interest.

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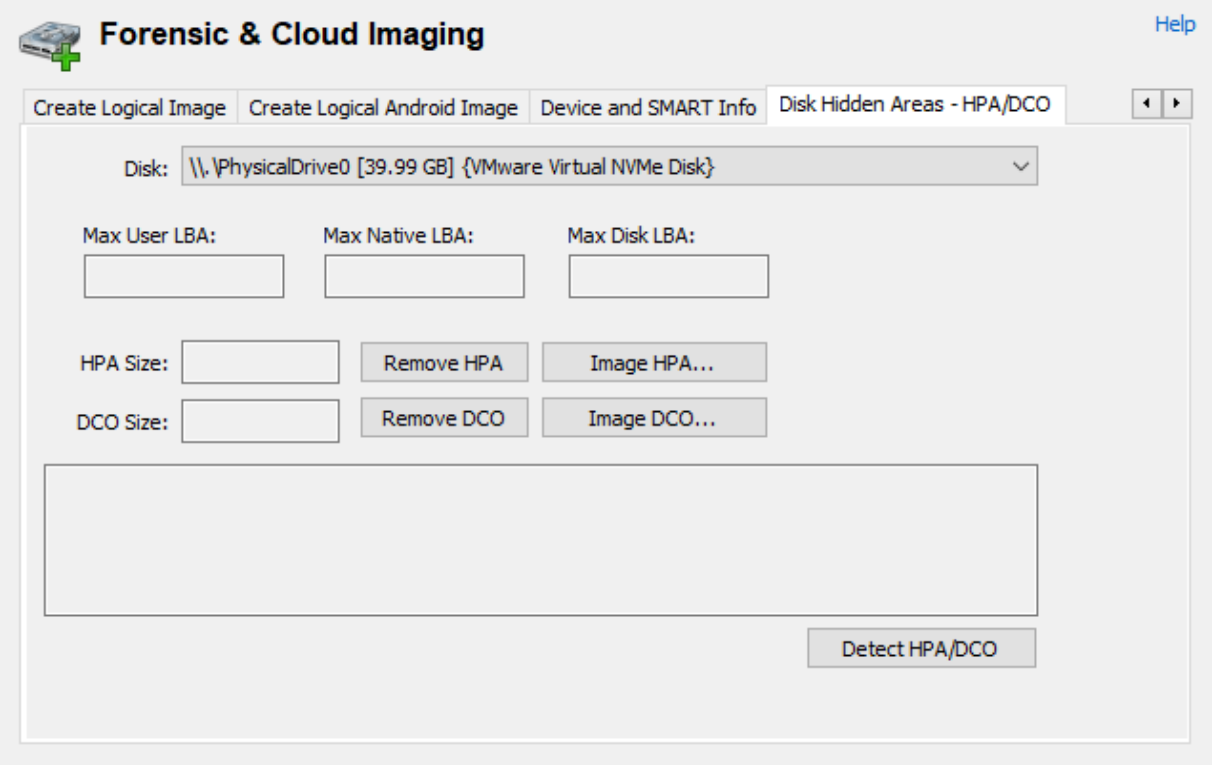
***Note**: If the HPA and/or DCO is removed, you will need to detach/re-attach the hard disk before the system is able to access the previously hidden sectors. Ie. You will be unable to view the previously hidden sectors in the Raw Disk Viewer until you detach/re-attach the hard disk. However, you can still view the contents of the hidden areas without detaching your hard disk by imaging the HPA and/or DCO to a file, and opening the image file in the internal viewer.*




**Max User LBA**
The maximum addressable sector by the user. This determines the capacity reported by the disk to the system.

**Max Native LBA**
The maximum addressable sector allowed by the disk.

**Max Disk LBA**
The maximum addressable sector of the physical disk.

**HPA Size**
The size of the area between the Max User LBA and Max Native LBA

**Remove HPA**
If present, the HPA on the specified disk is removed. The sectors that were previously hidden in the HPA are now accessible.

**Image HPA**
If present, an image of the HPA is created and saved to disk. The HPA is restored back to its original state after imaging.

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**DCO Size**
The size of the area between the Max Native LBA and Max Disk LBA

**Remove DCO**
If present, the DCO on the specified disk is removed. The sectors that were previously hidden in the DCO are now accessible.

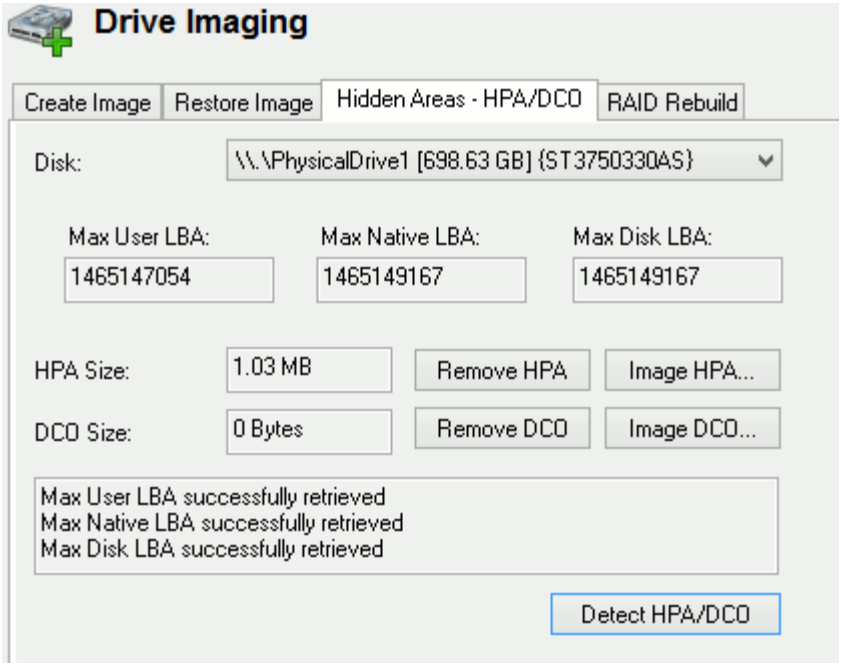
**Image DCO**
If present, an image of the DCO is created and saved to disk. The DCO is restored back to its original state after imaging.

*Note: DCO can only be removed if no HPA exists on the disk. Ie. The HPA needs to be removed first before the DCO can be removed and/or imaged.*

Depending on the hard disk, the HPA/DCO areas may be locked and therefore cannot be removed or imaged. This is indicated by "N/A" for the size of the area.

## Accessing the HPA/DCO

Once a hidden area has been detected use the "Image" button that corresponds to the particular hidden area, this will allow you the save the contents of the area as an image file, in the example shown below clicking the "Image HPA..." button will allows us to save the contents of the detected HPA.




Now that an image of the HPA has been created you can view it using the File System Browser and Internal Viewer. Navigate to the location where the HP image was saved, right click on the image file and choose the "View with Internal Viewer" options. Now you will able to see the HEX contents of the area and use the other internal viewer functions like "Extract Strings" as shown in the example below.

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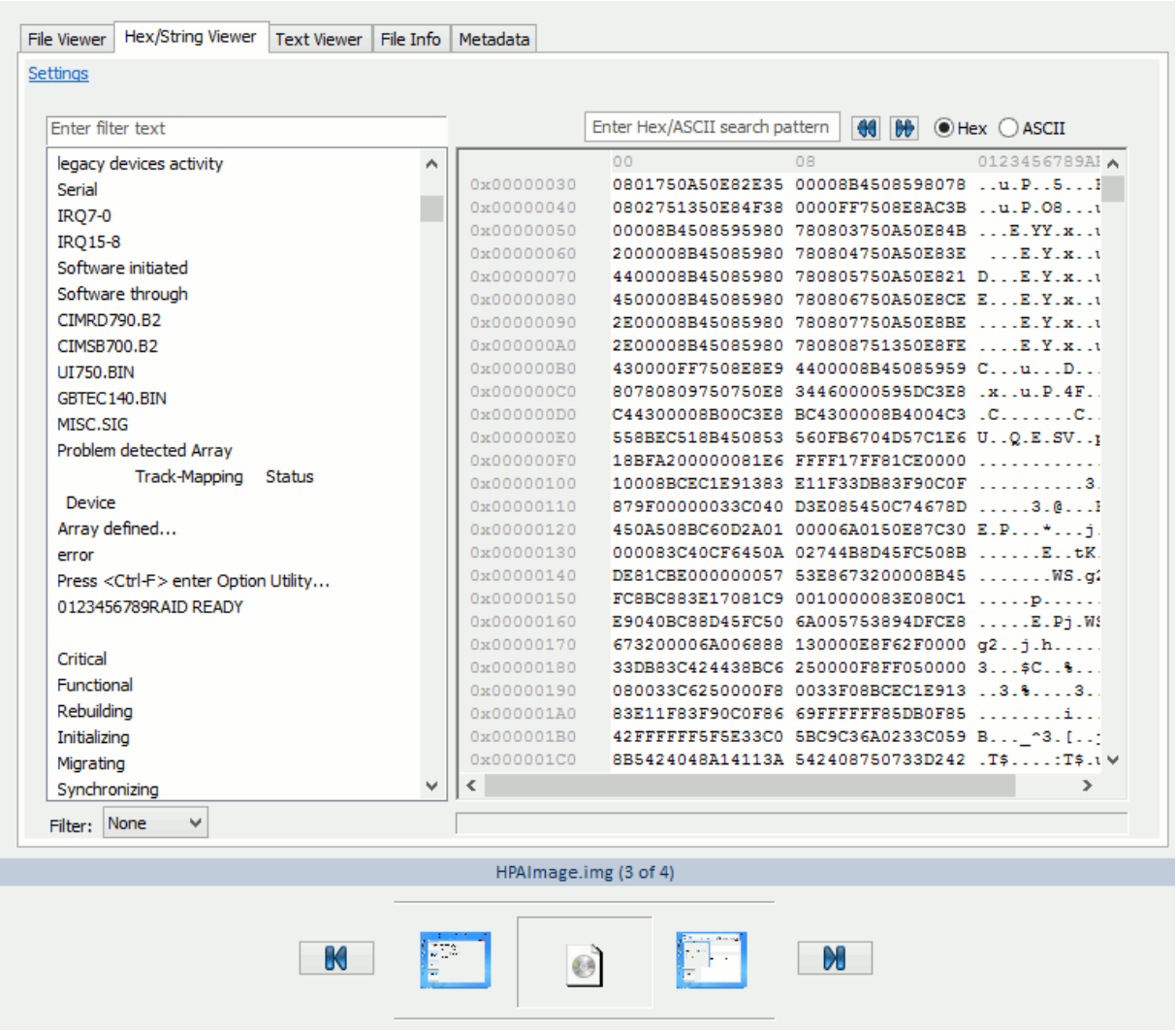


## 5.13.4 RAID Rebuild

RAID configurations are becoming more commonly found in consumer machines, not just in server machines. As such, being able to properly image systems with RAID configurations for forensics analysis is critical and sometimes challenging. This is due to the fact that having access to the controllers that manages the RAID array may not be possible. The forensics investigator may only have access to a set of disk images without knowing which RAID controller was used, and the RAID parameters used in the configuration.

OSForensics can rebuild a logical disk image from a set of physical disk images from a RAID array, given a set of RAID parameters. Depending on the controller used (software or hardware), some of the RAID parameters can be automatically detected. See Supported RAID Metadata Formats for a list of metadata formats that can be automatically detected.

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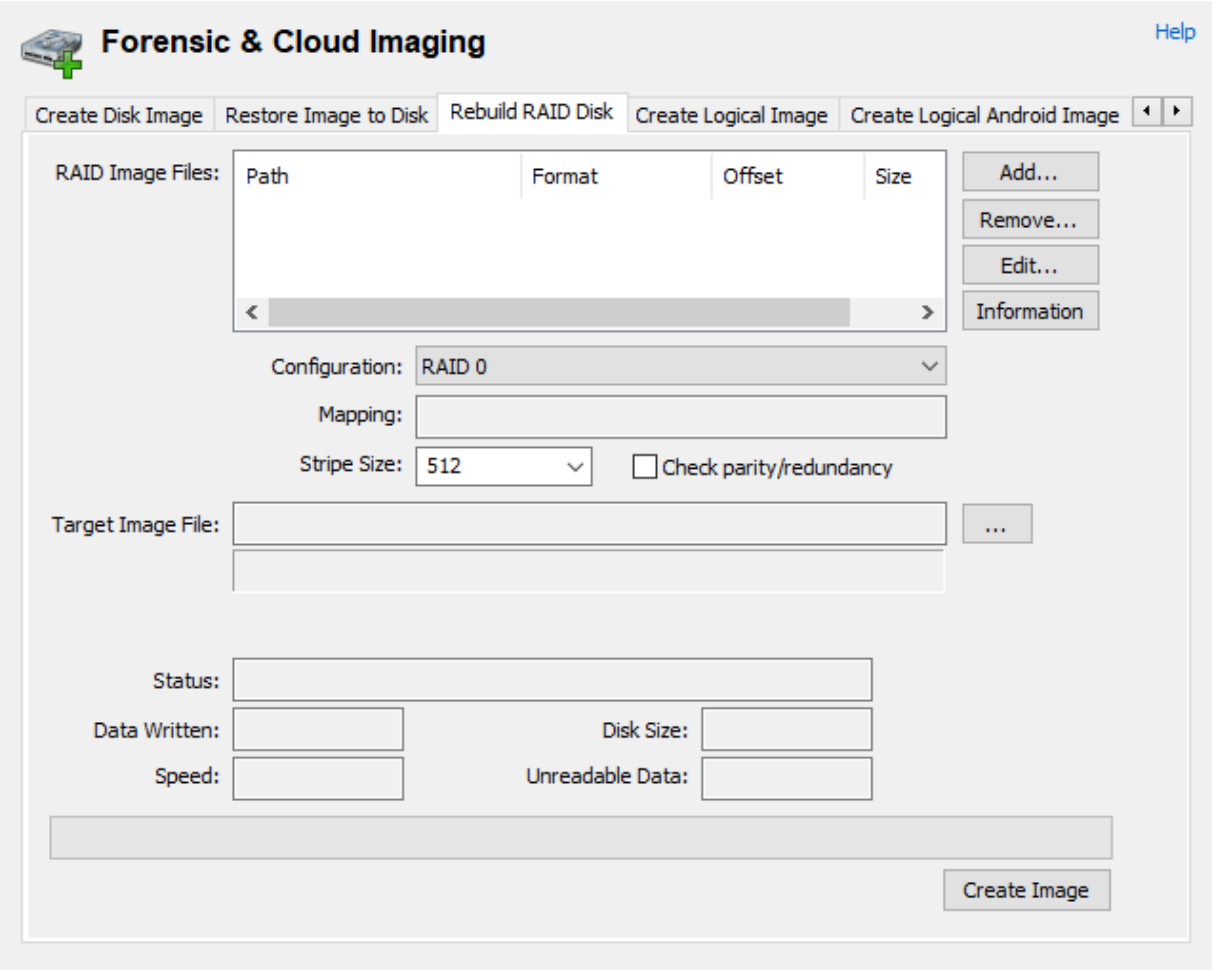


**RAID Image Files**
List of source image files from disks to rebuild from, in the listed order.

**Add...**
Adds an image file to the list

**Remove**
Removes the selected image file(s) from the list

**Edit...**
Modify the offset and size of the selected image file

**Info...**
Displays any metadata information associated with the image file.

**Configuration**
Describes how the disks are arranged to achieve a particular level of redundancy and performance

**RAID 0**
Arranges the disks to provide increased performance and capacity. Blocks of data are striped consecutively on consecutive disks

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**RAID 1**
Arranges the disks to provide increased reliability. Blocks of data are copied on the same physical block of all disks, resulting in all disks being mirror images of each other. Disk images configured in RAID 1 do not need to be reassembled (as all disks contain all blocks from the original image), but can be checked for integrity.

**RAID 0+1**
A nested RAID that combines RAID 0 and RAID 1, providing redundancy and performance. Two or more disks are arranged in RAID 0, which are then mirrored onto another set of disks. This creates a mirror of stripes.

**RAID 1+0**
Like RAID 0+1, RAID 1+0 is a hybrid of RAID 0 and RAID 1 configurations. In this case, a set of RAID 1 mirrors are arranged into RAID 0 configuration, creating a stripe of mirrors.

**RAID 3**
Arranges the disk to provide a balance between performance, capacity and reliability. Consecutive bytes are striped onto consecutive disks, with the last disk being used exclusively for parity bytes. As such, the last disk is not directly used in rebuilding the logical image but for verifying the integrity of the data.

**RAID 4**
Like RAID 3, this configuration provides a balance between performance, capacity and reliability. In this case, blocks of data (rather than single bytes) are striped consecutively on consecutive disks, with the last disk being used exclusively for parity blocks. Again, the last disk is not directly used in rebuilding the logical image but for verifying the integrity of the data.

**RAID 5**
Similar to RAID 4, the disk is arranged to provide a balance between performance, capacity and reliability. However, instead of having a disk exclusively for parity blocks, the parity blocks are distributed amongst all disks. This reduces the risk of losing data when a single disk fails.

> **Forward Parity (a.k.a. right asymmetric)**
> The parity block is rotated from the first disk to the last disk. For each stripe, the ordering of the data blocks start at the first disk, from left to right.
>
> **Forward Dynamic Parity (a.k.a. right symmetric)**
> The parity block is rotated from the first disk to the last disk. For each stripe, the ordering of the data blocks start at the parity block, from left to right.
>
> **Backward Parity (a.k.a. left asymmetric)**
> The parity block is rotated from the last disk to the first disk. For each stripe, the ordering of the data blocks start at the first disk, from left to right.
>
> **Backward Dynamic Parity (a.k.a. left symmetric)**
> The parity block is rotated from the last disk to the first disk. For each stripe, the ordering of the data blocks start at the parity block, from left to right.
>
> **Backward Delayed Parity**
> Similar to Backward Parity, the parity block is rotated from the last disk to the first disk. However, instead of the parity block rotating to the next disk on the next stripe, it is written on the same disk for a set number of stripes (called the delay). If the delay is 1, then this will be the same as Backward Parity.

**Spanned**

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This configuration is not a RAID level but is a simple concatenation of two or more disks to provide increased capacity.

**Mapping**
Provides the mapping pattern between a a physical disk/stripe pair to a logical block number, depending on the selected configuration. For example, the mapping for a RAID 5 (Backward dynamic) configuration is as follows:

| | Disk 1 | Disk 2 | Disk 3 |
|---|---|---|---|
| **0** | 0 | 1 | P |
| **1** | 3 | P | 2 |
| **2** | P | 4 | 5 |

The numbers represent the logical block number and 'P' represents a parity block. Each row represents a stripe. The mapping pattern would be the following 1-D array:

0, 1, P, 3, P, 2, P, 4, 5

**Stripe Size**
The size of the smallest unit of contiguous data addressable in a RAID array. In order to rebuild the logical image, the stripe size along with the disk ordering specified by the RAID configuration determines how the source disk images are striped to form the logical image.

**Check parity/redundancy**
If checked, the parity blocks (if present) are checked to verify the integrity of the RAID array

**Target Image File**
The location to save the rebuilt RAID image file to. After specifying the image file path to save to, the image file format shall be displayed below depending on the file extension used.

**Compression Level**
If the image file format supports compression, one of the following level of compression of the image file can be specified: None, Fast, or Best.

**Status**
The current status of the rebuilding process. Also shows a duration where available. Note that the duration is only for that particular step or the process.

**Unreadable Data**
If a sector was unreadable, it will fill that sector with 0's and continue on. This field lets you know how much data was unreadable, due to restricted access or a damaged disk.

#### 5.13.4.1 Supported RAID Metadata Formats

Typically when a RAID array is managed by a RAID controller, metadata describing the specific RAID parameters (eg. stripe size, RAID level, etc.) is written to the beginning or end of each member disk. This allows the controller to properly assemble the RAID array each time on power-up. However, the format of the metadata is different depending on the manufacturer of the RAID controller. The following table summarizes the metadata format that can be automatically detected by OSForensics when rebuilding a RAID array:

| Metadata Format | Tested |
|---|---|
| Intel Matrix RAID | Yes |

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| | |
|---|---|
| Linux mdadm RAID | Yes |
| SNIA DDFv1 | Yes |
| Highpoint v2 RocketRAID | No |
| Highpoint v3 RocketRAID | No |
| Adaptec HostRAID | No |
| Integrated Technology Express RAID | No |
| JMIcron RAID | No |
| LSILogic V2 MegaRAID | No |
| LSILogic V3 MegaRAID | No |
| nVidia MediaShield | No |
| Promise FastTrak | No |
| Silicon Image Medley RAID | No |
| Silicon Integrated Systems RAID | No |
| VIA Tech V-RAID | No |

### 5.13.5 Create Logical Image

Creating a logical image allows the investigator to copy files/directories from one or more source devices or complete Cloud Drives to a destination folder or image file, preserving as much file system metadata (eg. date/times, attributes) as possible. This is useful for cases where making a complete drive image of the evidence device is not preferable (e.g. due to disk size). Note that while the directory structure, file contents, and some metadata are preserved, some data may be lost from the operation such as slack space, fragmentation, unallocated space, deleted files, etc.

When specifying a destination target, the investigation can either specify a folder or an image file (Windows 7 or later) to copy the directory contents to. If the 'Image File' option is selected, a Virtual Hard Disk (VHD) image file is generated which shall contain the directory and contents. Before the copy operation takes place, a VHD image file is created, attached, and mounted to the system to a drive letter as an NTFS volume. Once the operation is complete, the virtual disk is detached from the system upon which the image file can be added to the case or re-mounted using Disk Management in Windows.

While the operation is running, a log is generated which contains the files/directories that were copied, general status messages and any error messages. The most common reason for failure is that they are locked by another process or the current user does not have permissions to access them. The log can be exported to a text file and/or added to the case as an attachment.

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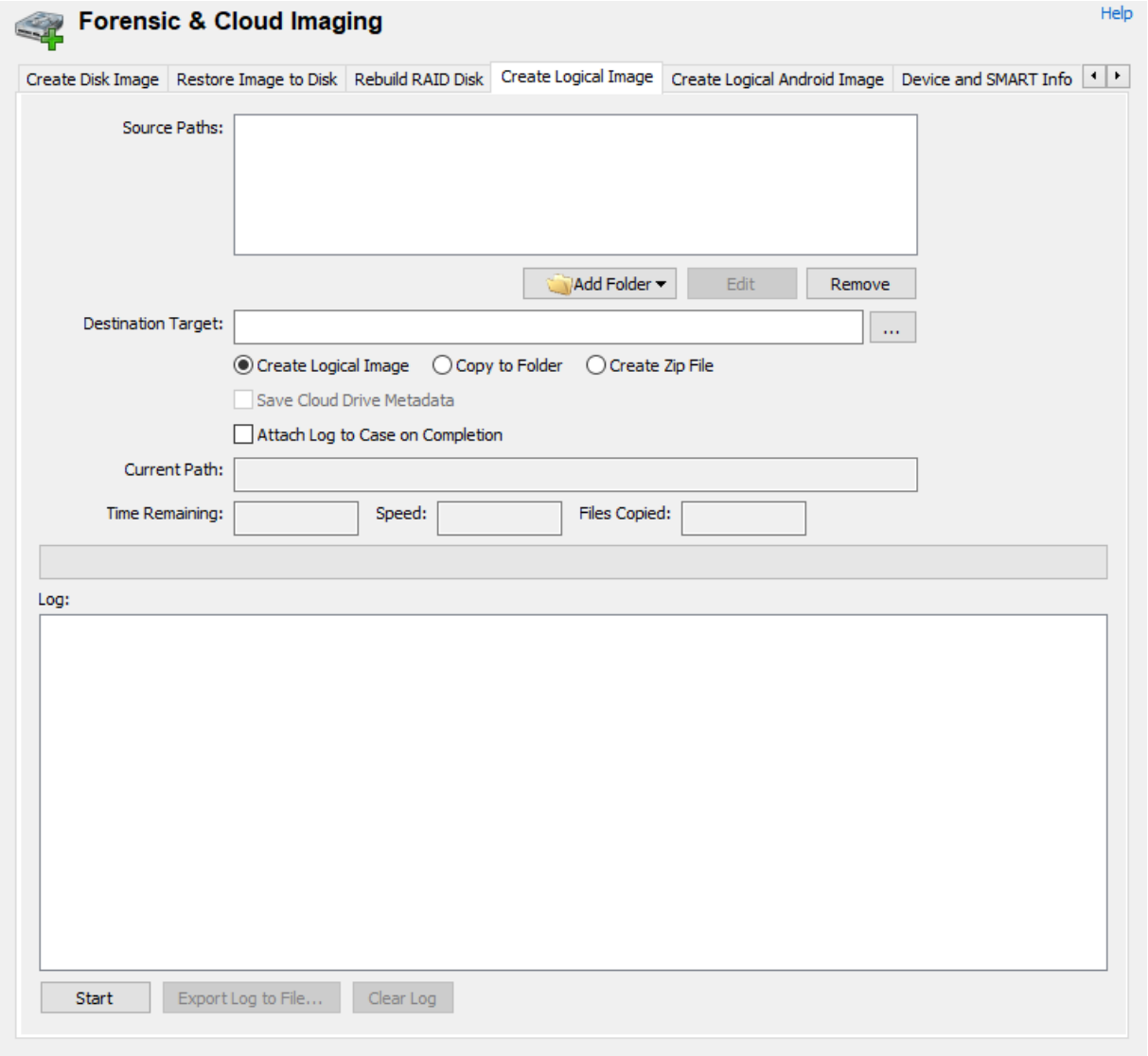


## Settings and Options:

**Source Paths**
The partition, disk, volume or device to create an image of. Note that only partitions with drive letters can be shadow copied.

**Add Folder** - Add a folder to be imaged
**Add File** - Add a file to be included in the image
**Import Files & Folders** - Import a list of file and folder paths from a text file
**Cloud Drive** - Add the contents of a Cloud Drive to the image
**Cloud Email** - Export the emails of a Cloud Webmail as an MBOX to the image

**Destination Target**
The location to save the image file (VHD) to (if **Create Logical Image** is selected) or the path to a local destination on the computer (if **Copy to Folder** is selected).

**Save Cloud Drive Metadata**

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When Cloud Drive is added to the source list, the option can be selected. When enabled, in addition to the file downloaded from the Cloud Drive, an metadata file with the extension ".meta-json" will be created in the same folder for each file. This file will contain the response from the cloud service API that may contain additional information that was stored with the file. The contents of the metadata will vary by the Cloud Drive Service.

**Attach Log to Case on Completion**
Upon imaging process completion, prompt the user to attach the imaging log file to case.

**Hash Copied Files**
Performs an MD5 and SHA256 hash on each item copied and displays the hash in the export log

## Import List Format:

**Format:**
- Each line contains a single file or folder path.
- Files and folders can be mixed in any order.
- Lines starting with # are treated as comments and ignored.

**Example:**
C:\Users\Jay\Documents\report.pdf
C:\Users\Jay\Projects\Source Code
#C:\Users\Jay\OldProjects\archive.zip (This line is ignored)
C:\Users\Jay\Downloads\App.exe

**How to Import:**
Click the "Import Files & Folders" button.
Select a text file containing the list of files and folders.
OSForensics will process and add them to the list view.

## File or Folder Source Items:

The following table summarizes the metadata that is preserved when performing a forensics copy of a **File** or **Folder** source Items

| | Preserved |
|---|---|
| Creation Date | ✓ |
| Last Accessed Date | ✓ |
| Last Modified Date | ✓ |
| MD5 | ✓ |
| SHA256 | ✓ |
| Last Attribute Modified Date | ✗ |

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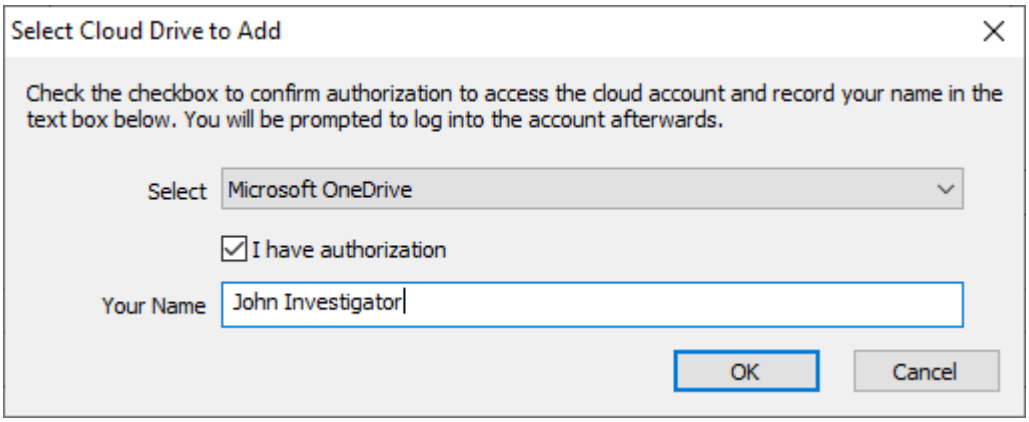
| | |
|---|---|
| File Attributes | ✓ |
| Short (8.3) file names | ✓* |
| Streams | ✓* |
| Owners / Groups | ✓* |
| Permissions (ACL) | ✓* |
| File fragmentation | × |
| Slack space | × |
| Deleted files/directories | × |

** Only if supported by the source/destination file system*

## Cloud Drive Source Item:

OSForensics currently supports downloading from Microsoft OneDrive (Owned files) and Dropbox (Owned/Shared files) accounts. When adding a cloud drive source, the user will be required to acknowledge authorization to access the remote drive and will be prompted via the system's default browser to log into the service afterward.




When **Save Cloud Drive Metadata** is enabled, an additional file (with extension .meta-json) will be created along with the downloaded file. The contents of the file will contain additional information that was obtained from the Cloud Drive service. The metadata will vary by service.

Example metadata from Dropbox:


```
{
        ".tag": "file",
        "client_modified": "2018-06-18T18:13:31Z",
        "content_hash":
"f7ad488deb7d81790340ecd676fe6e47f0a6064fb99b982685b752d58611c1cb",
        "has_explicit_shared_members": false,
        "id": "id:qWFLFkvdeUAAAAAAAAAABQ",
        "is_downloadable": true,
        "name": "Get Started with Dropbox.pdf",
```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```
        "path_display": "/Get Started with Dropbox.pdf",
        "path_lower": "/get started with dropbox.pdf",
        "rev": "2c82b3d90",
        "server_modified": "2018-06-18T18:13:32Z",
        "size": 1102331
}
```


### Cloud Mail Source Item:

OSForensics currently supports exporting webmail to MBOX format from Microsoft Hotmail/Outlook accounts. When adding a cloud mail source, the user will be required to acknowledge authorization to access the remote mailbox and will be prompted via the system's default browser to log into the service afterward. The resultant MBOX file can be accessed later using OSForensics' Email Viewer.

## 5.13.6 Create Logical Android Image

Creating a logical Android image allows the investigator to copy files/directories from an Android device to a destination folder or image file, preserving as much file system metadata (eg. date/times, attributes) as possible. This is useful for cases where obtaining an complete drive image of the evidence device is not possible (eg. device not rooted). Note that while the directory structure, file contents, and some metadata are preserved, some data may be lost from the operation such as slack space, fragmentation, unallocated space, deleted files, etc. Files are obtained using adb.exe pull command with the '-a' option which will try to preserve file timestamp and mode.

Additional artifacts can be retrieved using the **Extract Data with OSFExtract App** option. This will install the OSFExtract app onto the Android device and allow the retrieval of Messages (SMS, MMS), Contacts and Call Log from the device, that may not been retrievable using the Logical Copy method.

When specifying a destination target, the investigation can either specify a folder or an image file (Windows 7 or later) to copy the directory contents to. If the 'Image File' option is selected, a Virtual Hard Disk (VHD) image file is generated which shall contain the directory and contents. Before the copy operation takes place, a VHD image file is created, attached, and mounted to the system to a drive letter as an NTFS volume. Once the operation is complete, the virtual disk is detached from the system upon which the image file can be added to the case or re-mounted using Disk Management in Windows.

While the operation is running, a log is generated which contains the files/directories that were copied, general status messages and any error messages. The most common reason for failure is that the current user does not have permissions to access them. The log can be exported to a text file and/or added to the case as an attachment.

**IMPORTANT: To use adb with an Android device connected over USB, you must enable USB debugging on the device. This can be done in the device system settings, under Developer options on the Android Device itself.**

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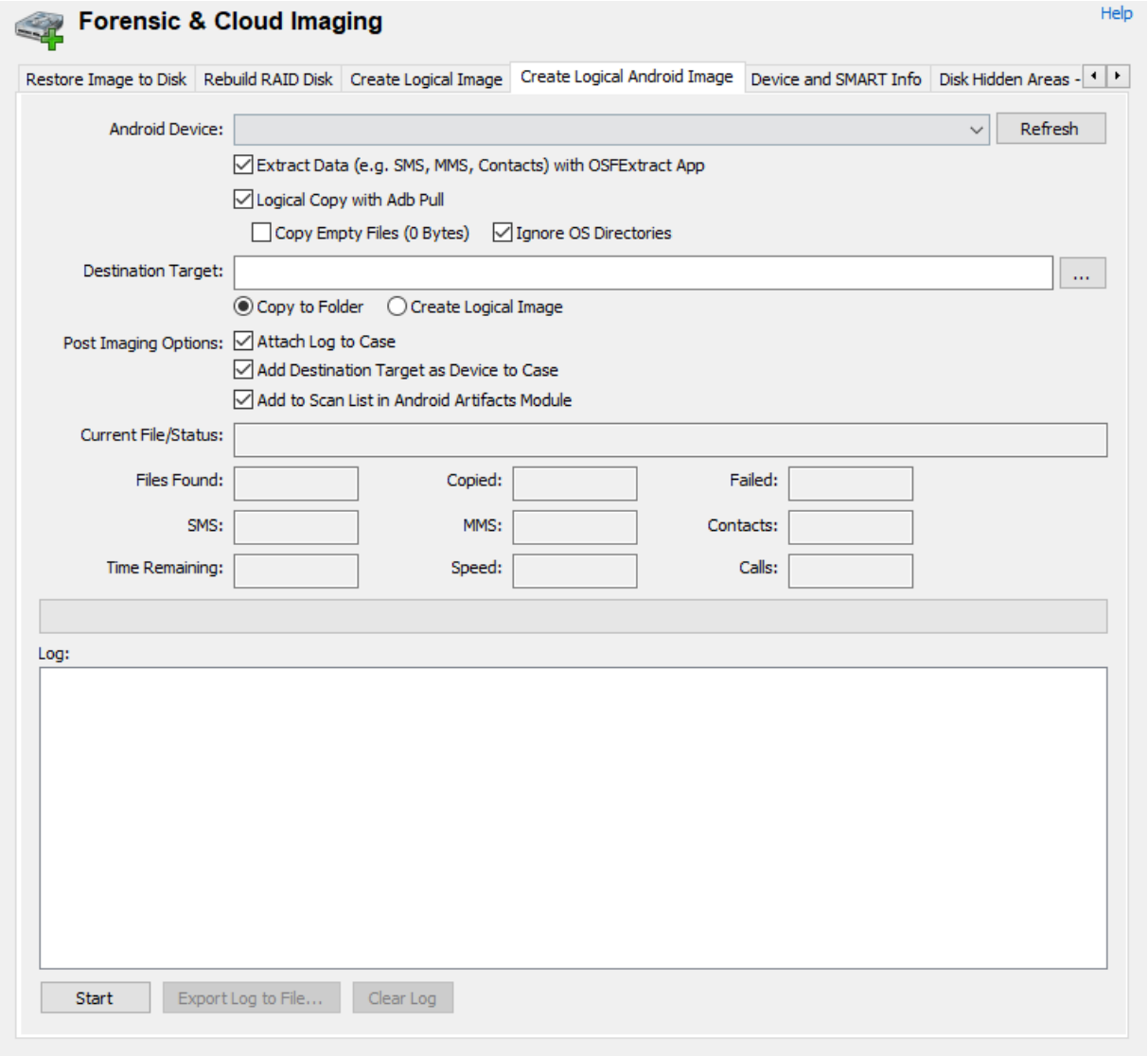


**Android Device**
This drop-down list will show a list of Android Devices currently connected to the PC.

**Extract Data with OSFExtract App**
Use the companion OSFExtract App to retrieve additional data during the imaging process.

**Logical Copy with Adb Pull**
Copy files/directories from an Android device to a destination folder using adb.exe pull command. adb.exe is distributed by Google and a copy of the application is installed with OSForensics.

**Copy Empty Files**
Enable this checkbox to include files that are listed as 0 bytes in size during the copy process.

**Ignore OS Directories**
Enable this checkbox to skip known Android OS Directories from being scanned/copied. Directories on the ignore list are: /sys, /proc, /dev, /etc, /sbin, /d, /acct.

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**Destination Target:**
The directory to save the files from the device (Copy to Folder) or location of an image file to write the contents to (Create Logical Image).

**Attach Log to Case on Completion**
A log is generated which contains the files/directories that were copied, general status messages and any error messages. When enabled, upon completion, OSForensics will add the log to the case.

**Add Image as Device to Case**
On completion, the she specified target directory can be added to the current case as a device to be used in other modules.

**Add to Scan List in Android Artifacts Module**
The path of the acquired image will be added to the scan list in the Android Artifact Module.

#### 5.13.6.1 OSFExtract

OSFExtract is an supplemental Android application that aids in the retrieval of Messages (SMS, MMS), Contacts and Call Log from a device. The application must be installed on the Android device and granted permissions to properly function and communicate with OSForensics. The app is installed onto the device when Extract Data with OSFExtract App option is checked when doing Logical Android Copy. Note: The device must be placed in Developer mode for OSForensics via Android Debug Bridge (adb) to install[1] and launch the app and to correctly forward ports to retrieve the data over USB.

The following permissions must be allowed for OSFExtract to access data on the device:
- Allow OSFExtract to send and view SMS messages.
- Allow OSFExtract to access your contacts.
- Allow OSFExtract to make and manage phone calls.
- Allow OSFExtract to access photos, media and files on your device.

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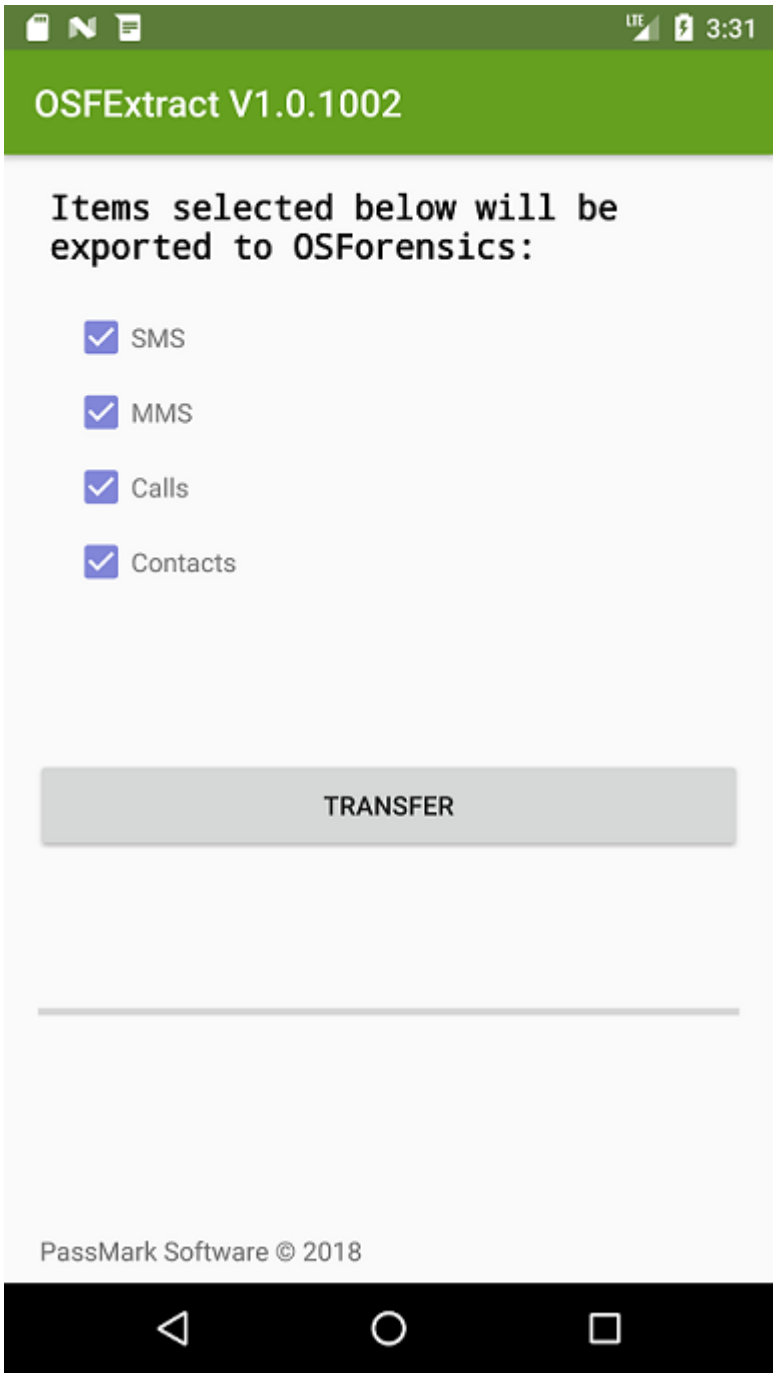



[1]To manually side-load the app, osfextract.apk can be found in the adb sub-directory in the program executable directory. However the program is not much use without OSForensics.

## 5.14 Hash Sets

Hash Sets allow an investigator to quickly identify known safe files (such as Operating System and program files) or known suspected files (such as viruses, trojans, hacker scripts) to reduce the need for

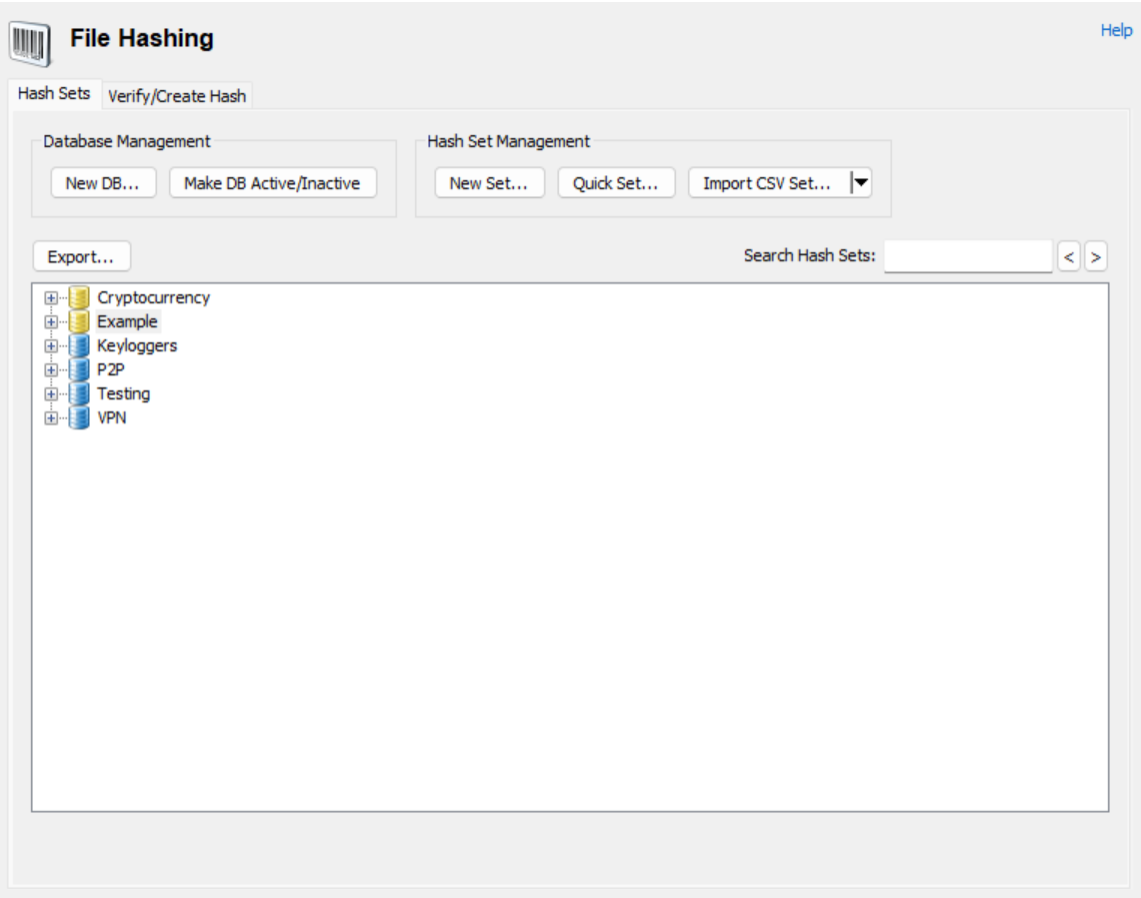
further time-consuming analysis. Hash Sets are used in a data analysis technique called Hash Analysis, which uses the MD5, SHA1 and SHA256 hash of files to verify the files on a storage device. A hash uniquely identifies the contents of a file, regardless of filename. In other words, any two files with the same hash are said to be the same. A collection of these hash values form a hash set, which can be used to reduce the time required to search a storage media for particular files of interest. In particular, files that are known to be safe or trusted can be eliminated from file searches. Hash sets can also be used to identify the presence of malicious, contraband, or incriminating files such as bootleg software, pornography, viruses and evidence files.

It is recommended when creating hash databases that safe files be kept in a separate database to files that are illegal/incriminating.

Once the hash sets are created, they shall be used throughout OSF where applicable (such as File Searching).

Included as part of OSForensics are sample hash sets from NSRL, a US government project that provides a repository for hash sets of known files. Additional sample hash sets can be downloaded from the Passmark website.

## Hash Set Management




**New DB**
Creates a new empty database. Clicking this button will prompt the user to provide a name for the database. After a valid name is entered, the database will appear in the list ready for use.

**Make DB Active/Inactive**
Makes the currently selected database active/inactive. The active database is the database that shall be used for all operations in OSF requiring hash sets. You can also make a DB active/inactive via right-click and selecting "Make Active/Inactive". Currently active database(s) are highlighted in yellow.

**New Set**
Creates a new hash set in the currently active database. Clicking this button will open the New Hash Set window where you can specify the creation options.

**Import CSV/NSRL/VIC/PhotoDNA Set**
Imports a hash set that was previously exported from OSF in csv format back into the currently active database.
Imports the NSRL (http://www.nsrl.nist.gov/) dataset into an OSForensics database. See this page for detailed instructions
Imports a VIC dataset into an OSForensics database. See this page for detailed instructions
Imports a PhotoDNA dataset into an OSForensics database. See this page for detailed instructions.

**Export**
Exports the currently selected item to csv format. If a single hash set is selected, then just the selected hash set is exported. If any other item is selected (eg. origin, DB) then all hash sets contained are exported.W

**Search Hash Sets**
This search box allows the user to search for a hash set by name. The search applies to all databases in the list. Enter all or part of the hash set name and use the ">>" and "<<" to move forwards and backwards through the list. The search is case insensitive.

## Hash Set List

The hash set list displays a list of all hash sets under the following hierarchy:

**Database**
|-- **Origin**
|-- **Product Type**
|-- **Hash Set**

Double clicking on a hash set will allow you to view its contents. Items (excluding databases) may be dragged and dropped to copy hash set(s) within/across databases. Right clicking on items in the list allows you to perform actions such as renaming and deleting.

Due to the relational nature of the database, be aware that all Product Types appear under all Origins, regardless of whether they have any content.

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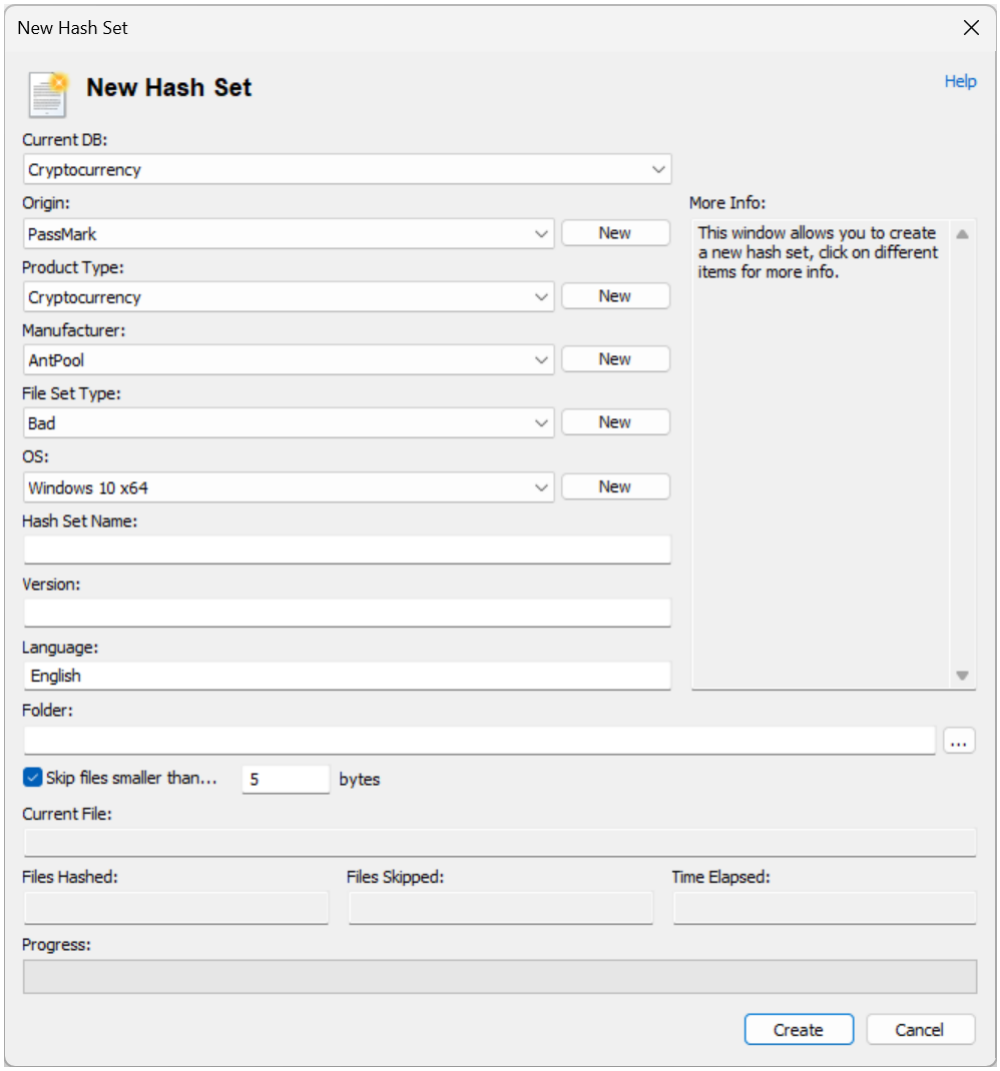
# Other Information

Installing Hash sets
Hash Set Lookup

## 5.14.1 New Hash Set

The New Hash Set window allows the user to enter the attributes for generating a new hash set. This window can be accessed by clicking on the "New Set" button in the main Hash Sets window.




**Current DB**
The name of the database that the hash set will belong to.

**Origin**
The origin of the files belonging to the hash set. Depending on the scope of the database this could be as specific as "Bob's PC" or as broad as an entire organization.

**Product Type**

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The product type the files are associated with. *Eg. Word Processor, Image Editor, Operating System.*

**Manufacturer**
The original creator of the files in the hash set. *Eg. Apple, Microsoft, Google*

**Set Type**
A classification for the set of files. *Eg. Safe, malware, bootleg, trusted*

**OS**
The Operating System the files are associated with.

**Set Name**
The name for the hash set. Hash set names should briefly describe the contents of the hash set. *Eg. Windows XP system files, viruses, blueprints.*

**Version**
The version of the product the files are associate with. *Eg. Microsoft Word 2007, Adobe Reader 9.*

**Language**
The language of the files in the set.

**Folder**
The directory to be scanned for files to be added to the hash set. All files and subdirectories in this folder shall be added to the hash set.

**Skip files**
If this checkbox is checked then any files smaller than the entered byte count will be skipped and not added to the hash set.
This is enabled by default due to the large amount of 0 byte and small files that can be present on a system which will create a hash entry that will match many files (due to the limited amount of unique hashes generated for small byte files).

**Current File**
The file that is currently being processed.

### 5.14.2 View Hash Set

The Hash Set Viewer window allows the user to view the details about an existing hash set. This window can be accessed by double clicking on a hash set or via the right click context menu in the main Hash Sets window.

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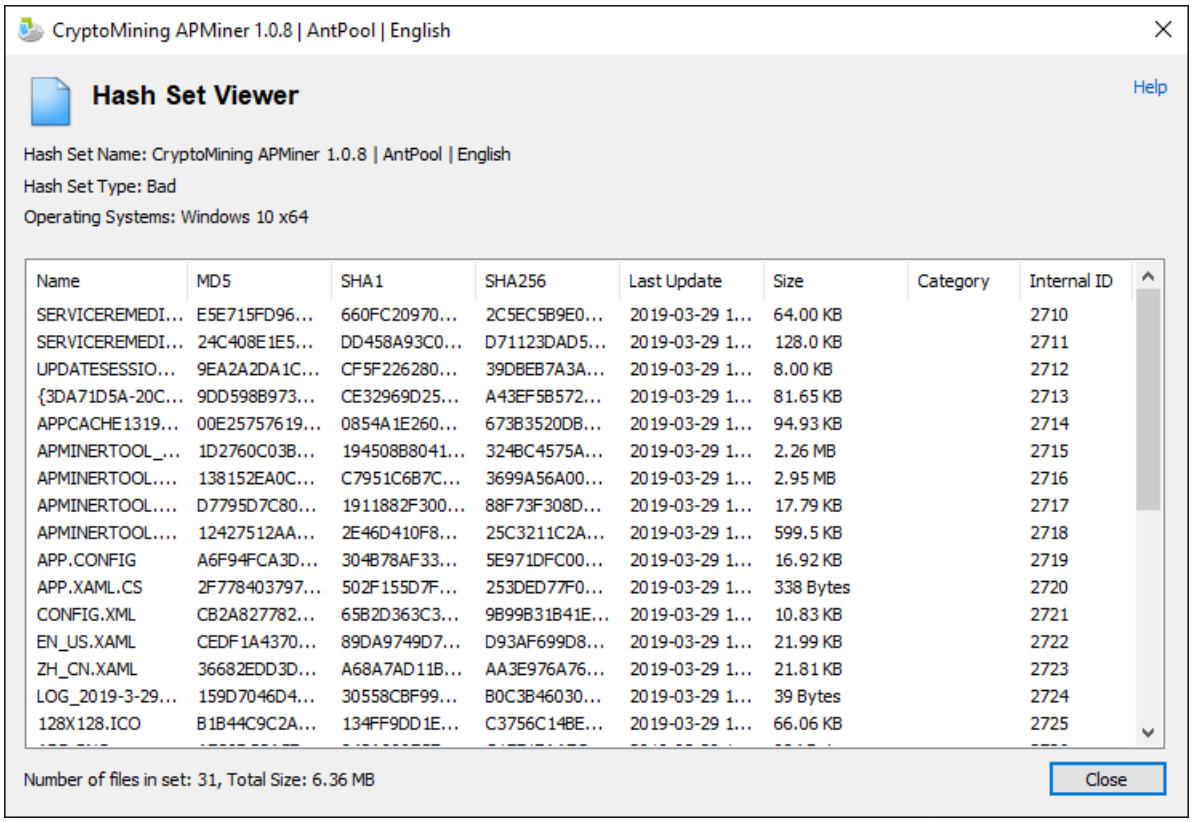
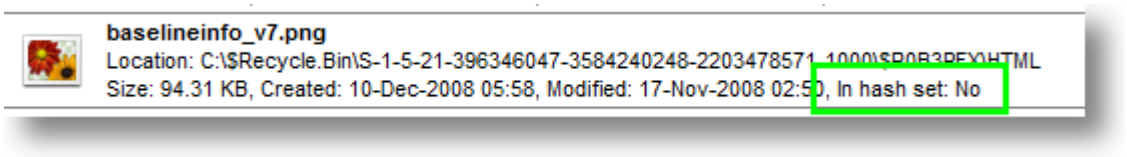



The table contains a list of files in the hash set and corresponding hash values.

### 5.14.3 Hash Set Lookup

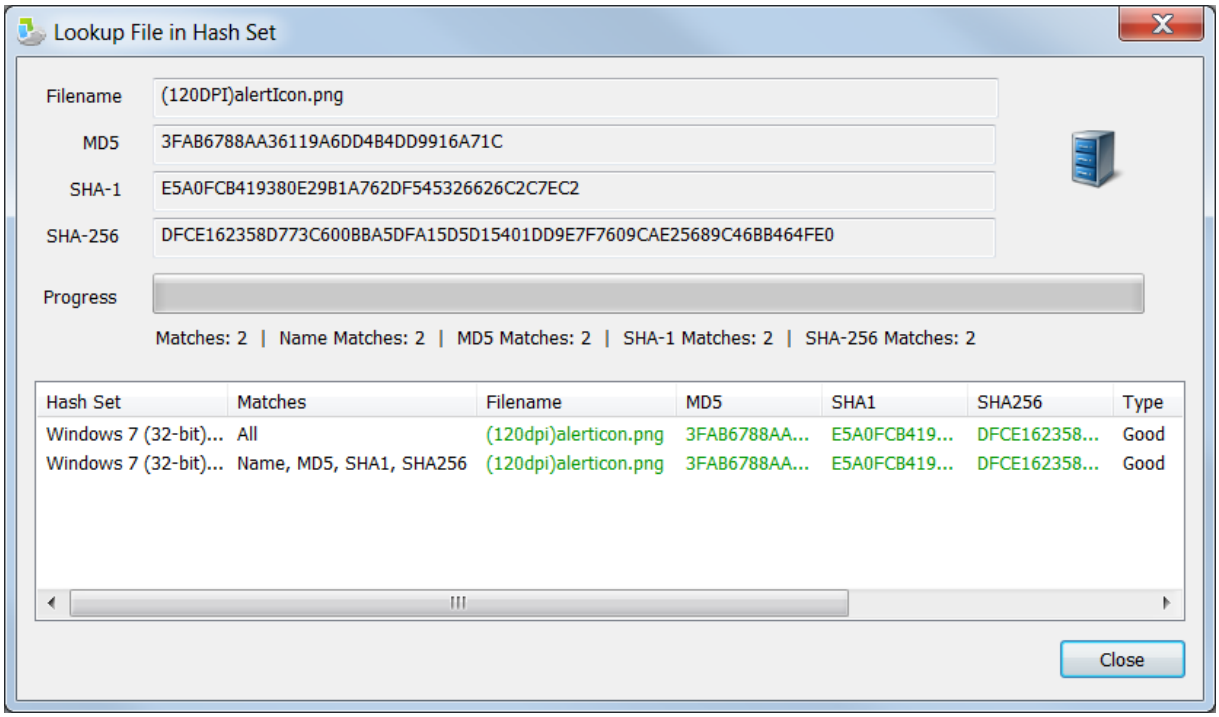
In either the File Name Search or the Mismatch Search module, it is possible to do a lookup on the files found to see if they exist within the current hash database. This is accomplished by right clicking in the list and choosing "Look up in Hash Set".

Depending on whether you do this for a single file or multiple files you will get a different interface. In both cases however the file will be marked in the original list as to whether a match was found.




## Single File Hash Lookup

The results of the lookup are displayed in the table, listing any matches that were found in a hash set in the active database.




Elements colored green indicate matches.

## Multiple Files Hash Lookup

When hash comparing multiple files at once, the files that matched the entries contained in the hash set are displayed in the list view.

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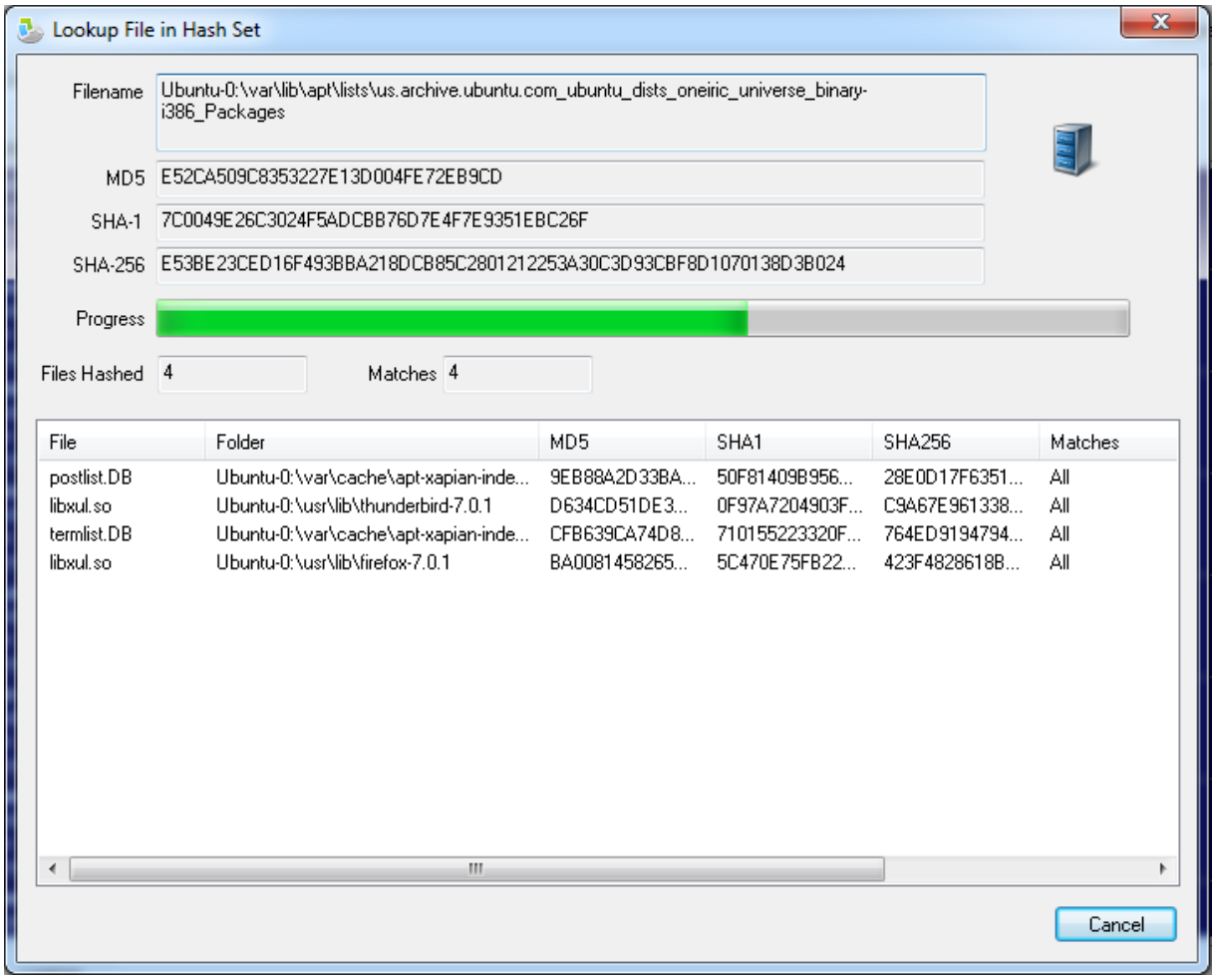


The list of matching files can be exported to a text file by selecting 'Export list to text...' in the right-click menu.

### 5.14.4 Installing Hash Sets

To install the hash sets from external sources, you must move them into the OSForensics program data folder.

On Vista, Windows 7 (aka Win7), and Server 2008, this would typically be the following folder (you may need to enable viewing of hidden directories to see it or enter it directly into the Explorer address bar):
C:\ProgramData\PassMark\OSForensics\hashSets

On XP and Server 2000/2003, it is typically something like this:
C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\hashSets

For a USB install
%OSF_Usb_Directory"%\AppData\hashSets
Note that while most files are automatically copied when installing to USB, hash sets are not as they can often be quite large.

You will then need to restart OSForensics if you have it currently open. When you next start OSForensics, you should now find additional sets listed in the tree view under the "Hash Sets" panel.

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Some additional hash sets you can install can be found on the OSForensics download page http://www.osforensics.com/download.html

### 5.14.5 NSRL Import

The National Software Reference Library data set can be obtained from this site http://www.nsrl.nist.gov/. To import the data set into OSForensics you will need to follow these steps.

1. Download the dataset from http://www.nsrl.nist.gov/. Currently the dataset can be distributed as a set of .iso files or as a zip, if the files are contained in a zip then unzip the files to a temporary folder (eg named "NSRLData") and go to step 3. To access the contents of the .iso files you will either need to burn them to DVD or mount them using a virtual disk manager such as OSFMount.
2. On each of the disks is a zip file, each of these zip files must be unzipped into a separate folder in the same location. For example, you create a folder named "NSRLData" and then under that folder you create folders named "Disk1", "Disk2" etc. in which you extract the zip files from each disk.
3. Select the "NSRL Import.." button on the hash management window.
4. Specify the input data folder, this will be the root folder for all the unzipped sub folders (the "NSRLData" folder in the example from step 2).
5. Specify the temp output folder. If this field is left blank, the database will be written directly to the final default location for hash sets. Otherwise, if this folder is specified, OSForensics will write the output database to a temp folder before copying it over to the final location. Therefore, specifying a location on a fast SSD or RAM drive can help speed up the import significantly (see below for more information).
6. Click "OK" and allow the import complete. A new database will be created automatically, and the database name will default to the format 'NSRL-YYMMDD-HH-MM'. To use a different name, wait for the import to complete, right-click the database in the tree, and select "Rename".

One way to speed up the process is to make sure the input data and the output data folder are on a fast solid state hard drive of a RAM drive. Import time is highly dependent on the random seek read/write performance of the drive. On an average system with a normal hard drive the process takes about 50 hours. On a RAM drive the process has been seen to take as little as 10-15. A solid state drive will likely have an import time somewhere between these two figures.

Important Note: The NSRL Import function assumes that in the input NSRLFile.text file, lines have been sorted in alphanumeric order. If not, errors may occur during the import.

#### Using a RAM drive

When creating a RAM drive to store both the input files and output files, it is important to allocate enough memory on the RAM drive, otherwise the import will fail once the drive runs out of space. While it is not possible to accurately predict what the exact size of the output files will be, the following example may be used as a rough guide:

For the NSRL RDS Version 2.59 December 2017 Modern RDS (minimal) dataset, the total size of the input files was 13.7 GB.
Once the import was complete, the output database file was 19.9 GB. (~1.5x the size of the input data)
Thus, at least 24GB was needed on the RAM drive to store both the input and output files.
Roughly this gives the following formulation:

Required memory = Size of input data x 2.5

It is also advised to add on a margin for error (e.g. 10%) if possible.

Note that this example is for the Modern RDS **microcomputer applications** dataset which contains many redundant entries due to there being multiple entries per file appearance in an application.

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OSForensics only stores one file hash entry per file appearance in an application (appearances occurring on different operating systems are ignored by OSForensics).
The Modern RDS **minimal** dataset also contains some redundant entries but less so than the above, so the output file size factor would be higher.
The Modern RDS **unique** dataset contains only unique hash values, so the output file size factor would be higher than both of the datasets mentioned above.
More information on the different datasets can be found at the NIST website.

### 5.14.6 VIC Import

To import a Project VIC .json file, click "*Import Project VIC Set...*", select the .json file to import, and click "OK".

You will then be prompted if you wish to import the VIC set into an existing database. This allows you to incrementally add hashes into the same database. Click "Yes" to proceed, or "No" to create a new database.

Correctly formatted project VIC files will import file hashes into a series of file sets with a maximum number of 100,000 file hashes per file set.

Note that the process can several hours to complete, and could even take several days on some systems.

An indicator of bytes read displayed at the bottom of the window can be used as a rough guide to calculate the time remaining.

You can also select "*Import Project VIC Set Folder*" and specify a folder that contains .json files. OSF will attempt to import each of these .json files into the same database and omit any which are duplicates.

OSF currently supports Project VIC file formats version 1.2, 1.3 and 2.0.

NOTE: While "Category 0 (Zero)" is officially documented as files of "Unknown" category, in the data we've seen this has been treated as a category for "safe" files, and so OSF currently excludes importing all hashes with a "zero" category.

### 5.14.7 PhotoDNA

#### What is PhotoDNA

PhotoDNA is a proprietary image hashing and identification technology developed by Microsoft. It is intended to provide a unique identifier for individual images for use in automatic detection of illicit material.

PhotoDNA differs from traditional hash based solutions and was developed specifically for the identification of images. Traditional file hashing identification relies on the underlying binary data of the file remaining perfectly consistent in order to reproduce the original hash value. Image files however are often subject to variations of their underlying binary data, this can be caused by file format changes, modifications to meta-data or deliberate alterations to the image.

To combat this, PhotoDNA utilizes image recognition technology in order to generate unique hashes separate from the underlying file data. This technique ensures that the same hash can be calculated

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even if the image has been re-sized, compressed, re-exported, deliberately altered or had meta data changed or removed or modified.

### Who Can use PhotoDNA

Use of the PhotoDNA API for the generation of image hashes is currently limited to qualified organizations and is subject to licensing on an organization by organization basis. For this reason, PhotoDNA functionality is not included in the base install of OSForensics and access to the functionality must be requested in order to use. More information about PhotoDNA and becoming a qualified organization can be found on the Microsoft Website.

### How to Install PhotoDNA

Once granted access to PhotoDNA, the relevant files needed to enable its functionality can be downloaded from the Passmark software management page. Official copies of PhotoDNA not provided by Passmark can also be used if the minimum version requirements are met. The contents of the folder should be unzipped and placed in a folder titled "PhotoDNA" in the root install directory of the OSForensics application. The functionality should now be enabled for all modules throughout OSForensics.

### Supported Versions

PhotoDNA is available only in OSForensics V11.0.1000 and up and currently supports the following PhotoDNA versions:

- PhotoDNA Version 1.05.20160330
- PhotoDNA Version 1.72.20170329

## 5.14.8 Hash DB Import/Export Format

The import / export format for the hash database is a flat CSV file with the following fields.

| Field Name | Format | Required Field? | Default Value | Description |
|---|---|---|---|---|
| Origin | String | No | Default | The origin of the file hash. |
| Product Type | String | No | Default | A description of the what type of product the product is. |
| Hash Set Name | String | Yes | - | The name of the hash set. This field cannot be empty. On the tree-view hash set name will appear as follows: <Hash Set Name> <Version> \| <Manufacturer> \| <Language> |
| Hash Set ID | Integer | No | 0 | A Unique ID of the hash set used to group the files into different hash sets. This value is used temporarily during the current import process and OSF will not store it in the database. If this field is empty or given the same value for all lines, all the imported hashes will be added to the same hash set. |

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| Field Name | Format | Required Field? | Default Value | Description |
|---|---|---|---|---|
| Version | String | No | 1.0 | The version of the product. |
| Manufacturer | String | No | NA | The manufacturer of the product. |
| Language | String | No | NA | The language of the product. |
| Hash Set Type | String | No | NA | What type of hash set this is.<br>e.g. known good files, known bad files, etc |
| OS | String | No | NA | The operating system this hash set is associated with. |
| File Name | String | No | NA | The name of the file this hash was taken from. |
| MD5 | String<br>(32 characters) | No | | The MD5 hash for this file. |
| SHA1 | String<br>(40 characters) | No | | The SHA1 hash for this file. |
| SHA256 | String<br>(64 characters) | No | | The SHA256 hash for this file. |
| PhotoDNA | String | No | | Currently CSV import of PhotoDNA is not supported but the comma separator for this field still has to be added. |
| Last Updated Date | yyyymmddHHMMSS<br>e.g.<br>20240131235959 | No | Local system time | Date and time when this hash was last updated.<br>Leave the field empty if you want to use the local system time. |
| Size | Integer | No | 0 | The size of the file in bytes that was hashed. |
| Category | Integer | No | 0 | Category index of this item. |
| Tags | String | No | | The tags for this file. |

**Note:**

- Use comma to separate each field.
- The required field cannot be empty. e.g. If the Hash Set Name is empty, the line will be skipped to import.
- The field can be empty if it's not a required field but the comma separator has to be there to identify different fields.
- The Default Value will be used if a given non-required field is empty.
- At least one of the MD5, SHA1, SHA256 fields has to exist.

**Example of CSV Import:**

```
Origin,Product Type,Hash Set Name,Hash Set ID,Version,Manufacturer,Language,Hash Set Type,OS,File Name,MD5,SHA1,SHA
Internal,NSRL,Known Images,999,1.0,,English,Bad,None,ImgFile1.jpg,912ec803b2ce49e4a541068d495ab570,,,,,1024,,"Image,N
Internal,NSRL,Known Videos,777,1.0,,English,Bad,None,VideoFile1.mp4,7c03aeb8031097d35caf3416a1826139,,,,20231231235
Internal,NSRL,Known Videos,888,1.0,,English,Bad,None,VideoFile2.mp4,8f01b1b9946594d17996e4eea1e3da2b,,,,20240131225
Internal,NSRL,Known Images,999,1.0,,English,Bad,None,ImgFile2.jpg,0cb471c88d2da4dcb430393aa0c0effa,,,,,512,,"Image,NSR
```

*** Note that the first line is excluded as it is assumed to be a header definition.**
*** If any of the hashes of the line being imported already exists in the active database, then the hash line will be skipped.**

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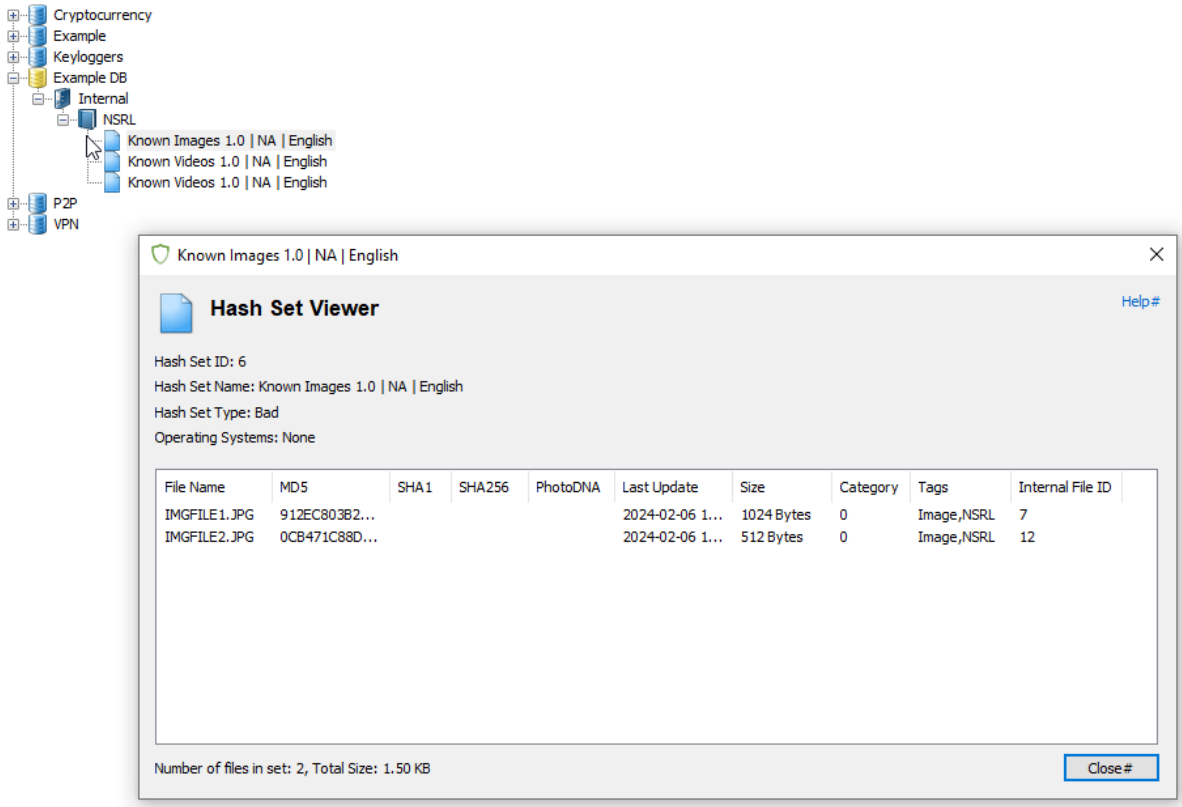
The screen shot below shows the result of CSV import from the example provided.
The 1st and 4th files are grouped together since they have the same Hash Set ID 999.
Whereas the 2nd and 3rd files are not, because they have different Hash Set IDs 777 and 888 respectively, therefore two different hash sets were added to the tree-view and the two hashes were put separately one in each.




## 5.15 Image Analysis

OSForensics utilizes deep learning models to analyze images, allowing you to search for images based on the Face Detection score or Illicit Image score.

All image analysis is performed entirely offline by OSForensics. No image content, nor the resultant data is ever transmitted from the investigation machine running OSForensics. Confidentiality is ensured.

### Face Detection

Upon analysis, OSForensics will return a confidence score (out of 100%) on each possible face that has been detected in an image. As multiple faces may appear in a single image, these individual scores are weighted and amalgamated into a final ranking score (as used for sorting in File Name Search), so a score may exceed 100% when there is the possibility of more than 1 face found.

When the Analysis is executed from the Internal Viewer, the potential faces are marked with a green bounding box and the percentage score appears next to the detected face.

### Illicit Image Detection

Using deep neural network based machine learning models, OSForensics is able to score images on how likely it is to contain illicit content.

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- A score over 80% is classified as "Likely illicit"
- A score of 50% to 80% is classified as "Possibly illicit"
- A score below 50% is classified as "Unlikely illicit"

## 5.16 Indexing

Indexing allows you to search within the content of many files at once. Unlike the other search modules which only inspect filenames and other surface criteria, indexing allows you to perform deep searches inside the content of PDF documents, Word files, E-mails, image meta data and much more.

In order to do this, you must first create an index for the set of files you wish to examine. This is a thorough process which scans and analyzes the files and builds an index (consider it to be a more sophisticated version of what you would find in the back of a book), which can then be used to perform searches on.

The following modules are used to perform index-based searches.

**Create Index**
Module that performs the initial index generation required for an index-based search

**Search Index**
Module that performs an index-based search using the index files created via the Create Index module.

### 5.16.1 Create Index

Creating an index allows the investigator to perform lighting fast, content-based searches across the entire drive or section of the drive. This process involves scanning the content of files and emails on the hard drive, and then constructing an index of the words found.

TIP: 64-bit OSForensics is highly recommended when indexing large sets of data.

If you are having problems with the indexing not completing properly or having a lot of errors see this page for common causes and solutions.

#### Step 1: Select File Types to Index

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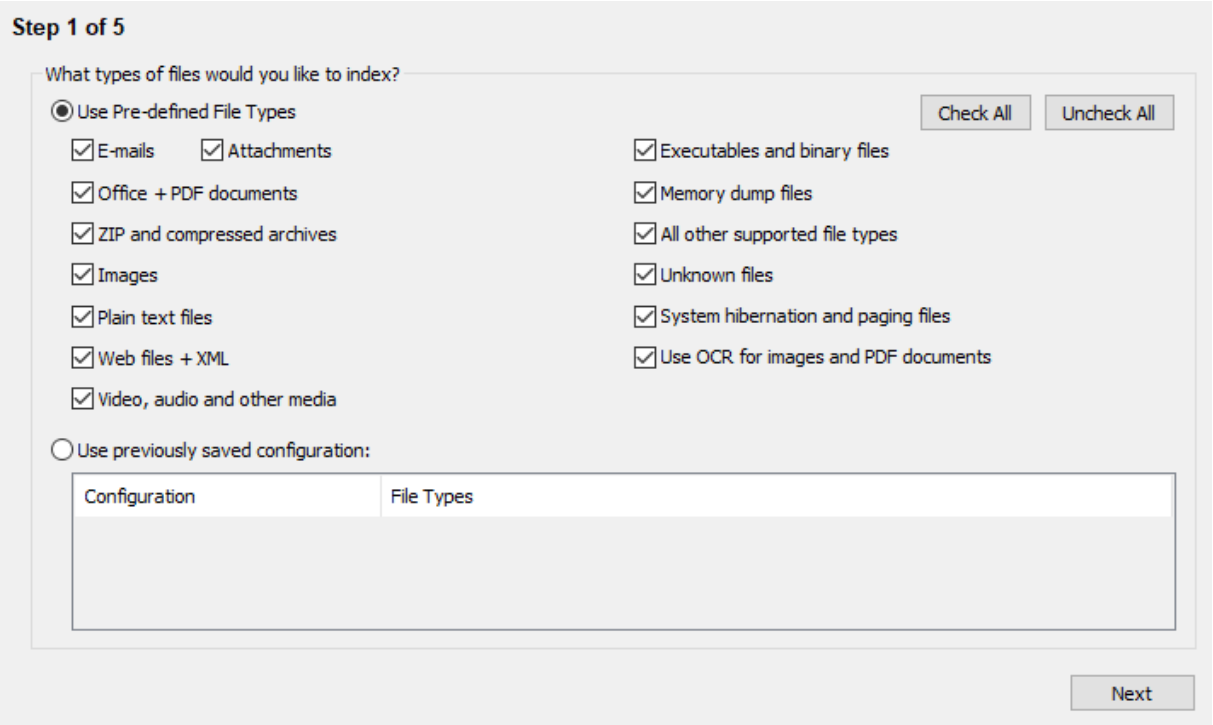


In this step you must select what kind of files you wish to index. You can select between a predefined set of file types or you can load from a previously saved configuration. In general, the more file types that are selected, the longer and more resource consuming the indexing process will take.

**E-mails**
Scan e-mail files found on the disk. Supports .pst, .ost, .msg, .eml, .mbox, .mbx, .dbx and .msf files.

**Attachments**
Scan all attachment documents found in email messages.

**Office + PDF Documents**
Scan Microsoft Office documents, OpenOffice documents and PDF files. Supports .doc, .dot, .ppt, .pps, .pot, .xls, .xlt, .docx, .pptx, .xlsx, .dotx, .pdf, .odt, .sxw, .ods, and .odp.

**ZIP and compressed archives**
Scan the contents of ZIP archives for files that match the other selected types. As such you should select other file types along with this option as zip files are merely containers and don't contain much interesting information in and of themselves. Other compressed archives supported are: .zipx, .tar.gz, .tar, .tgz, .taz, .rar, .arj, .dmg, .iso, .chm, .bz2, .lzo, and .7z

**Images**
Scan image files for metadata information. Supports .jpg, .gif, .tiff, .png and .bmp.

**Plain Text Files**
Scan plain text files and rich text documents.

**Web Files + XML**
Scan HTML web pages and scripts including .html, .htm, .shtml, .shtm, .xml, .xhtml, .php, .asp, .aspx, .cfm, .js, .pl, .cgi, and .swf files.

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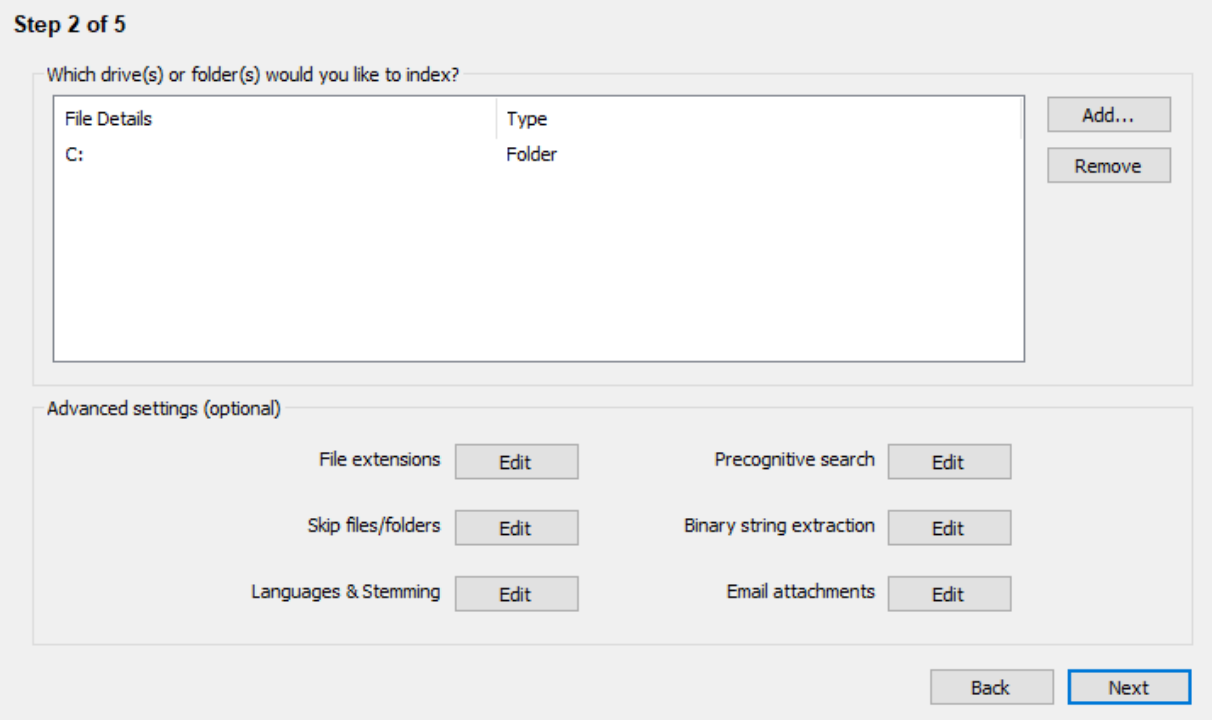
**All Other Supported File Types**
Scan all other supported types of files supported by the indexing process. This includes the following file types: .nfo, .dat, .wpd, .mp3, .dwf, .torrent, .mht, .avi, .wmv, .mpg, .mpeg, .rmv, .rmvb, .flv, .mov, .qt, .exe, .dgn, .wma, .tar, .gz, .cab, .rar, .psd, .qbb

**Unknown Files**
Scan files whose type cannot be determined by their extension or have no extension at all. The indexing process will attempt to identify what kind of file it is dealing with. This option can somewhat increase indexing time as a far greater number of files will be scanned.

**System hibernation and paging files**
Scan system hibernation file (hiberfile.sys) and system page files (pagefile.sys). Text strings will be extracted from these system files, which are typically very large. This option will significantly increase indexing time and indexed data. We advise a separate index for these files.

## Step 2: Location and Advanced Options




In this step, you will specify start directories where OSForensics will scan for files to index. Click the 'Add' button to specify the start location you want to add to the list:

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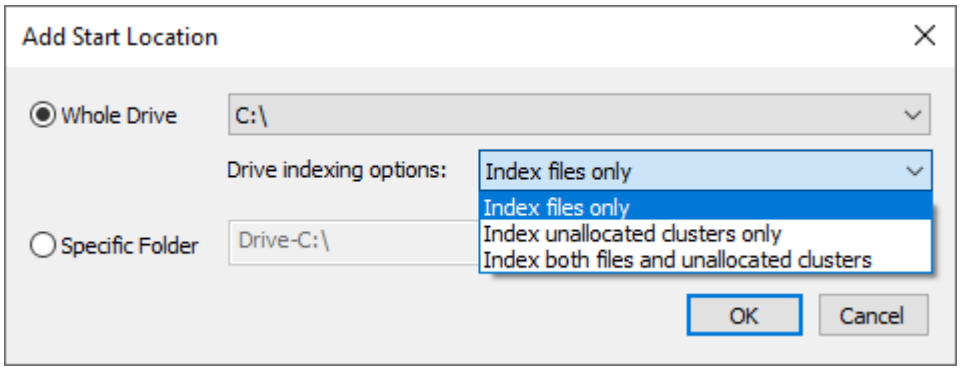


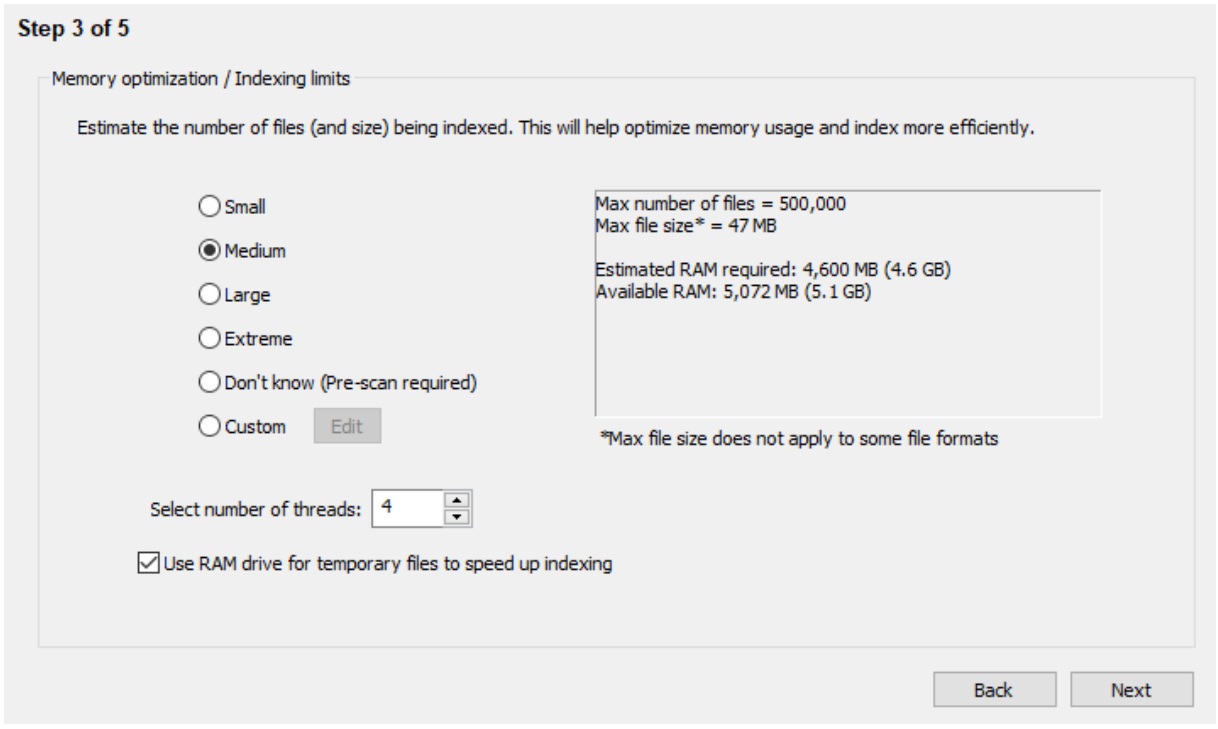

You may specify an entire drive, or a specific directory (eg. "My Documents" folder) to index. For Whole Drives, you have the option to scan the drive's unallocated clusters as well. However, this will greatly increase the indexing time and resource requirements. Indexing of unallocated clusters is available for all supported file systems.

If you choose to index unallocated clusters, then the file types you have selected are ignored for the data found in the unallocated clusters. In a sense there are no files in unallocated clusters. Any data found in unallocated clusters is treated the same. The strings are extracted and added to the index. Even if, for example, a fragment of data in unallocated clusters was once part of an .doc file, it still isn't processed like an Word document. Only string extraction is done.

### Advanced settings (optional)

On Step 2, you can also configure advanced indexing settings such as File Extensions, Skip files/folders, Languages, Precognitive searches, and more. Click on the "Edit" button to configure each of these groups of settings. For more information, see "Advanced Indexing Options".

## Step 3: Memory optimization / Indexing limits

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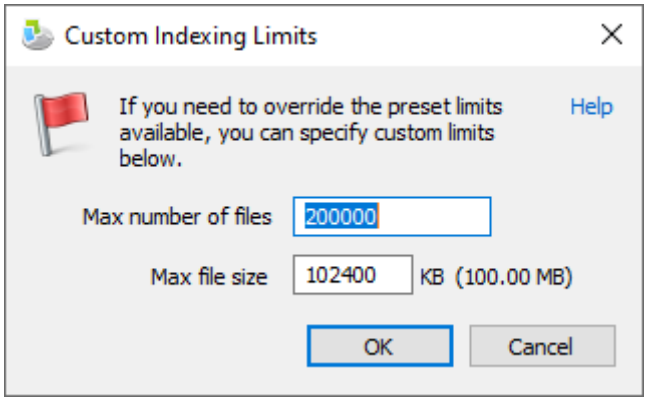
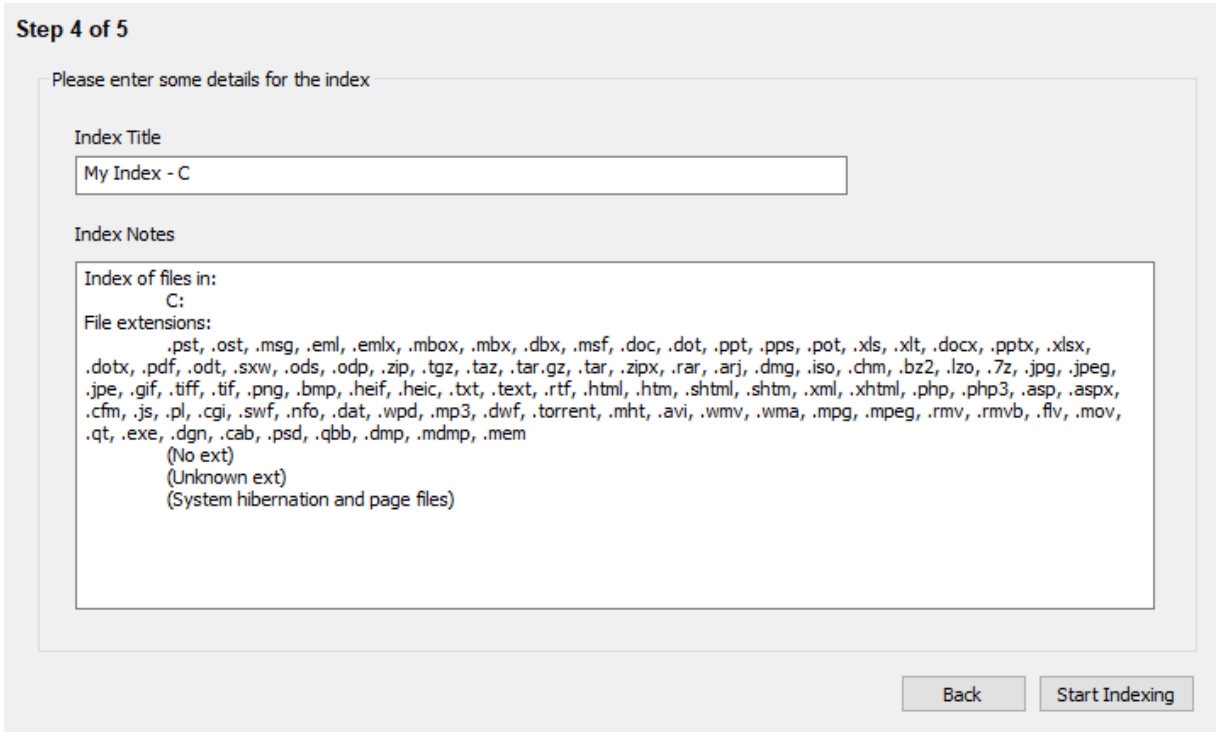
In order to index the files more efficiently, OSForensics needs to know the approximate number of files and the maximum file size that will be scanned. If this is not known, you can select 'Don't know' which will conduct a preliminary scan of the location and files to determine the proper limits for the indexing process. To set custom limits, select 'Custom' and click on 'Edit' to bring up a dialog box for specifying the limits.




TIP: To reduce indexing time even further, check 'Use RAM drive'. For more information see 'Indexing with a RAM drive'.

## Step 4: Case Details




In this step, you will need to enter details for this index to be added to the case. If you do not have a case open, you will be prompted to create/open one before moving to the next step. This step allows you to specify a title and notes for your index that will be stored in the case.

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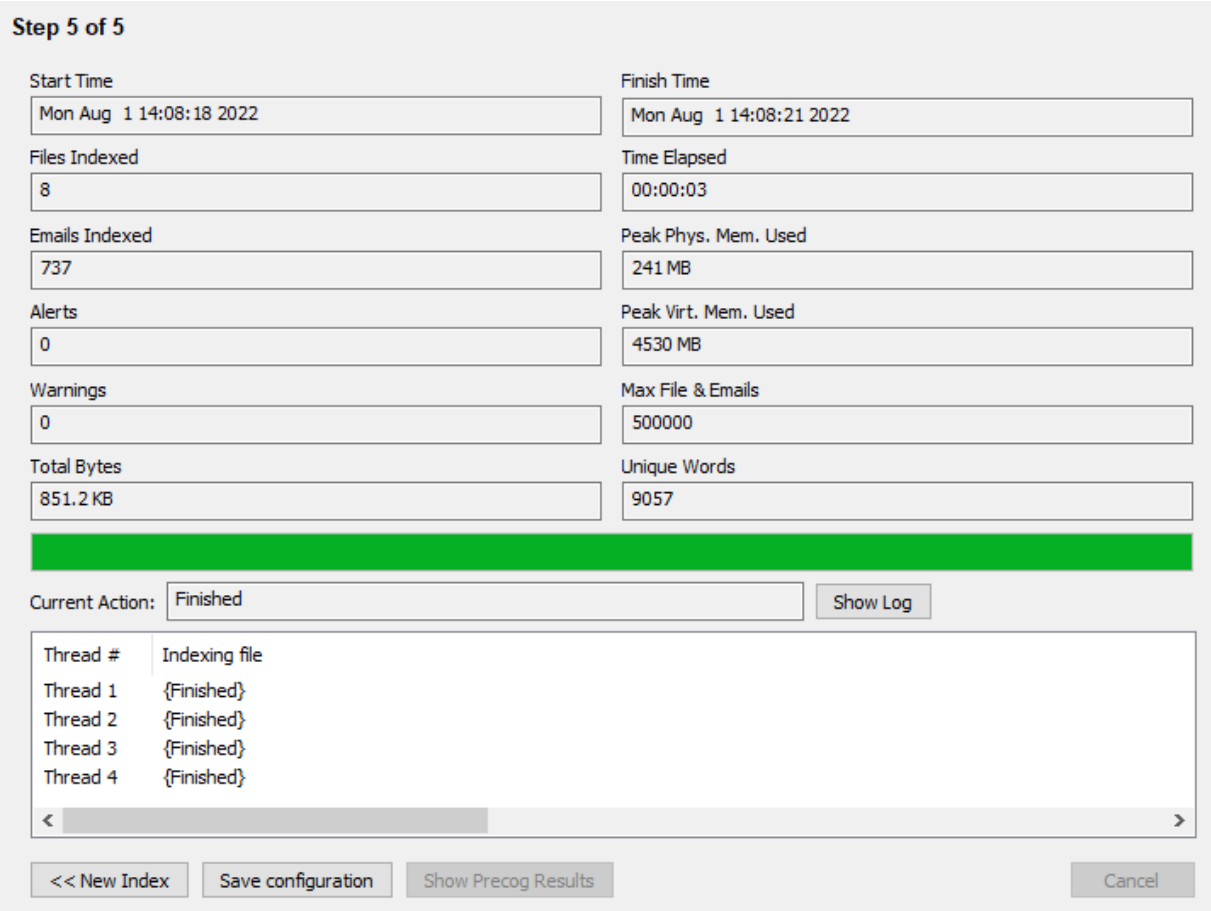
## Step 5: Indexing




The index is now being created. This process can take quite a long time depending on the options selected. To view the log in real-time while indexing is being performed, click on 'Open Log...' to bring up a log window as shown below.

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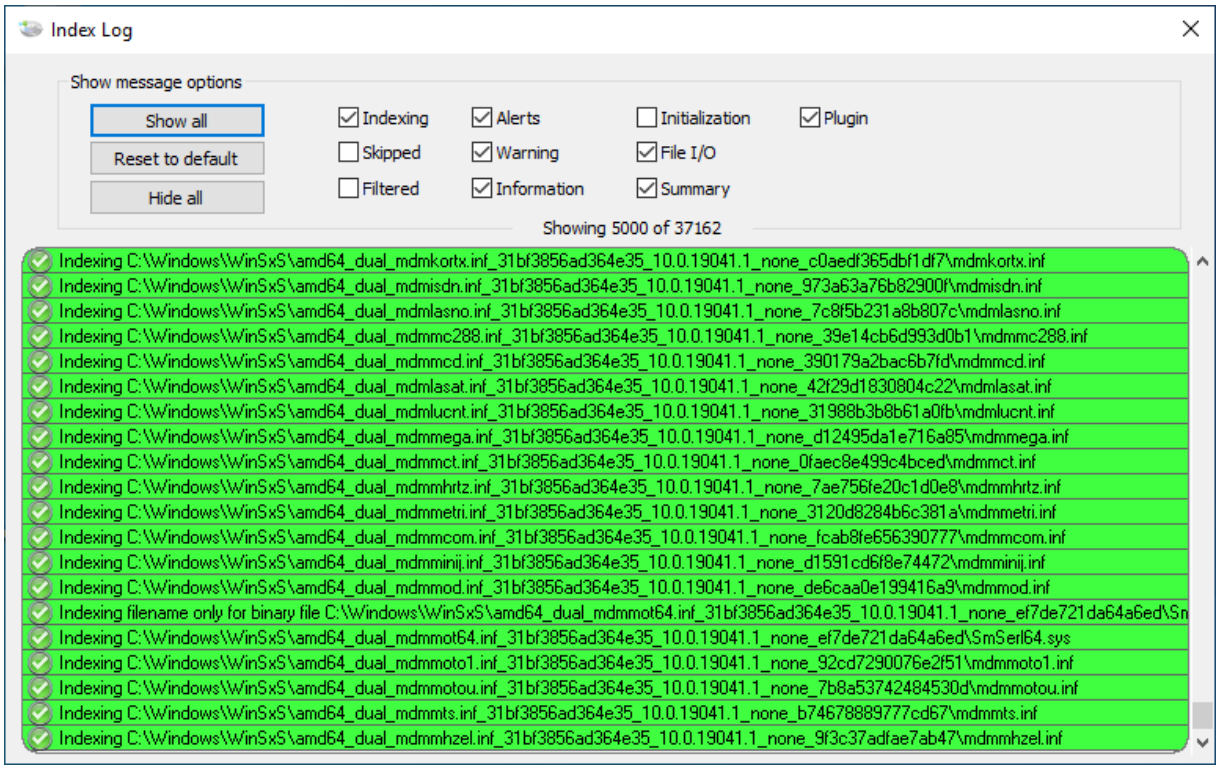


The log entries can be filtered according to the message type.

At the end of the indexing process, if no critical errors occurred, you will now be able to search against the index via the search index module.

### Additional Information:

See the following pages for more detailed information about the specifics of some of the data gathering.
Advanced Indexer Options
Indexing Problems and Solutions

#### 5.16.1.1 Indexing Problems and Solutions

### The indexing process fails due to not enough memory

Indexing uses a lot a memory, especially for large file sets. If indexing a large number of files it is highly recommended to use the 64-bit version of OSForensics if possible which has far higher memory capacity (also a machine with lots of physical memory will help). If this is not possible, or you are still encountering errors even with this, there are a few other things you can try.

Don't index unallocated sectors, this is a highly intensive operation.

Breaking up the index into several smaller indexes. For example, one for emails, one for office documents or an index for the "Program Files" directory and an index for the "Users" directory. This will mean that each index will need to be searched separately however it will allow you to overcome the limitations of the indexing process.

Reducing the maximum file size indexed in the advanced indexing options can also greatly reduce the amount of memory needed. 99% of files indexed will probably be less then 1MB, however if the pre-scan detects a single 1GB file the indexing process will use that much extra memory. By excluding a few very big files you can greatly reduce the memory requirements.

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### The log file shows a lot of errors about files being locked

If you are indexing an active system drive (the drive windows is running from) this is quite common as many programs and windows itself will be using the files on the drive making them inaccessable. Usually these files are system files without much interesting text in them and this should not be a problem.

### The log file says the max number of pages was reached

During the pre-scan step OSForensics tries to detect the number of files that will be included in the index and sets this as the maximum the indexing process will scan. Because the pre-scan is a rough and fast scan it may sometimes get this wrong. If this is the case you should try indexing again by setting the maximum pages manually in the advanced options.

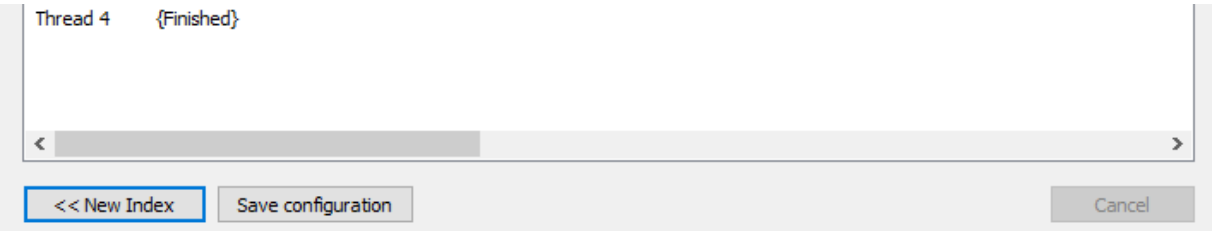
### Limits on recursive indexing

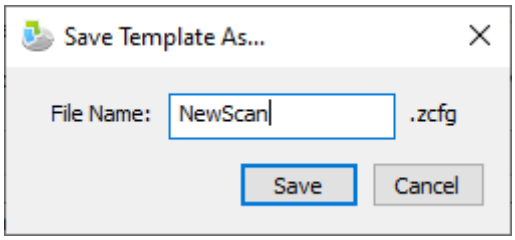
When indexing archive files like ZIP, there is a limit to the number of recursions that can take place. For example, when a ZIP file contains a ZIP file, this requires a recursive indexing. OSF is currently designed to index up to 16 levels of recursion in archive files.

For e-mails containing attachments (which may themselves be another e-mail containing yet another attachment), OSF will successfully index recursively until the URL is too long to return meaningfully as a search result. There is no fixed depth limit for recursively indexing e-mail attachments.

#### 5.16.1.2 Save Indexing Configuration

Saved configurations allow the user to specify a previously saved configuration. Once indexing has completed, you can save your configuration in Step 5 of the index creation procedure.




To use the saved configuration, select 'Use previously saved configuration' from Step 1 of the index creation procedure.

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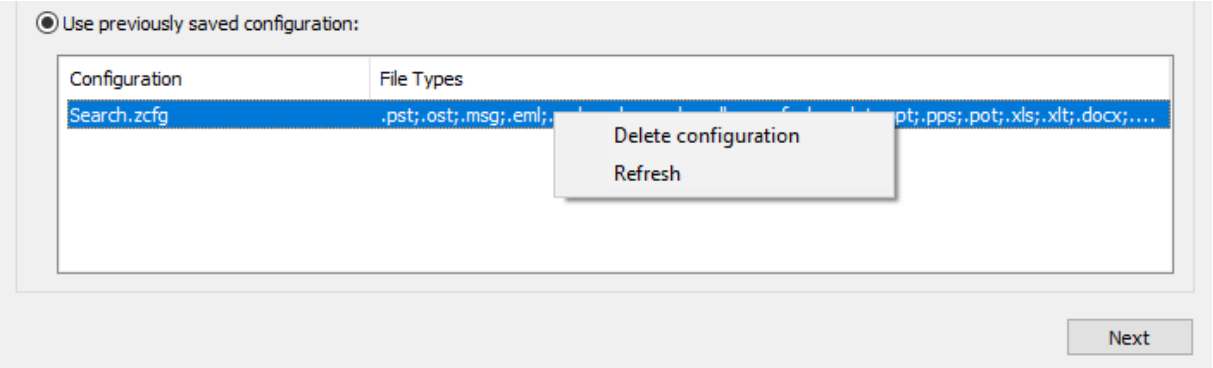


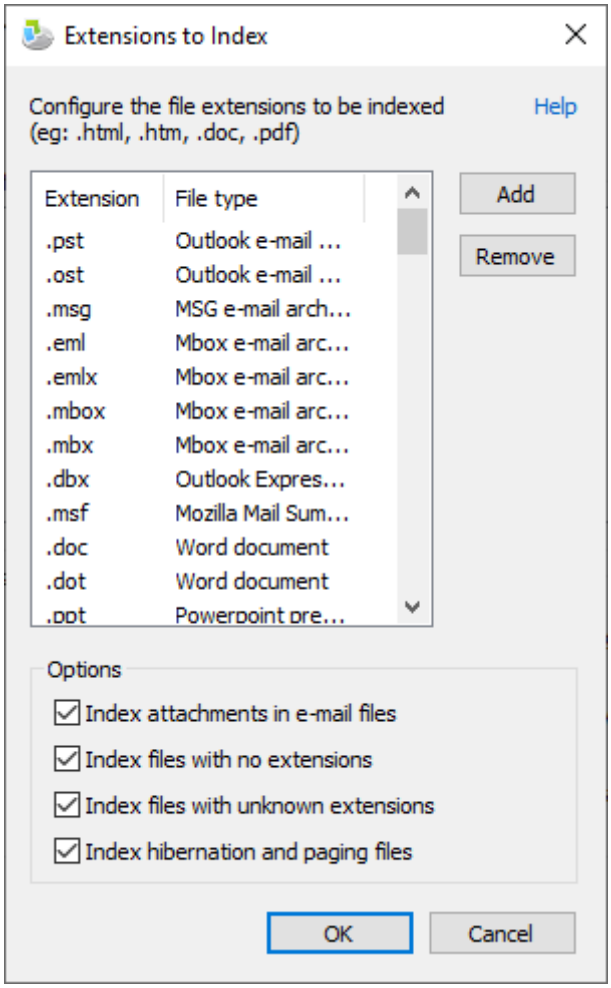

## Delete configuration

Deletes the template file from OSForensics

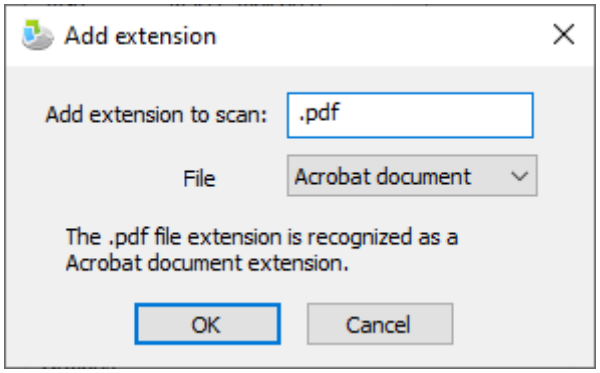
### 5.16.1.3 Advanced Indexing Options

Under step 2 of the "Create Index" module, you can Edit the following advanced indexing options.

## File Extensions



The list of file types whose contents will be scanned are configured here. Typical file extensions are added to the list by default. To add a new file extension, click the 'Add' button.




The user must specify the file extension and the associated file type to include the new file extension in the indexing process. To remove a file extension, click the 'Remove' button

**Index attachments in e-mail files**
If checked, attachment files found in e-mails will be indexed. Note that attachment files can be of many different file types.

**Index files with no extensions**
If checked, files without an extension are included in the indexing process

**Index files with unknown extensions**
If checked, files not included in the list are included in the indexing process

**Index hibernation and paging files**
If checked, Windows system hibernation (hiberfile.sys) and page files (pagefile.sys) are indexed. Text strings will be extracted from these system files, which are typically very large. This option will significantly increase indexing time and indexed data. We advise a separate index for these files.

## Page and folder skip list

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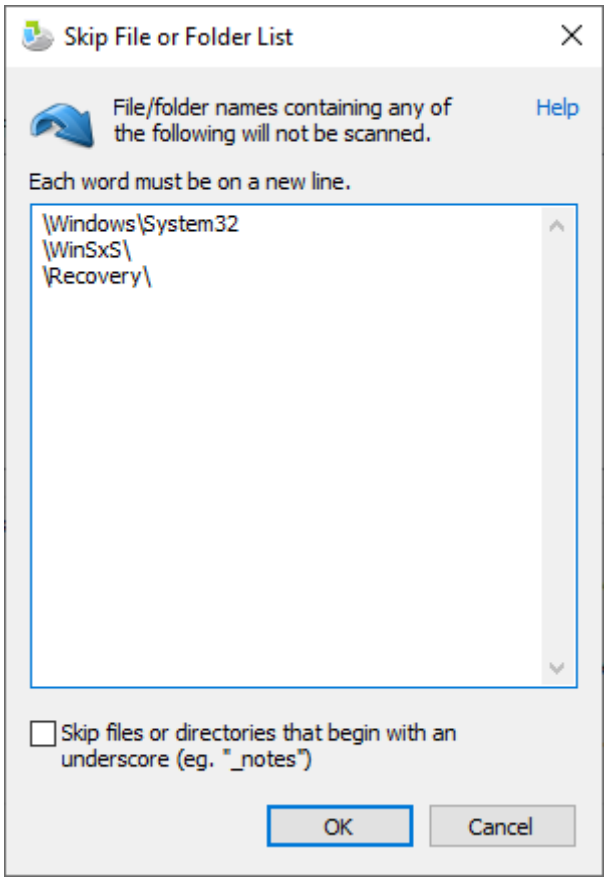


Pages and folders containing particular words can be excluded from the scan by adding the words to the list. Note that the folder the created index files are written to is also automatically added so that the indexing process does not index the files it is creating. This folder is a sub folder of the currently active case folder.

**Skip files or directories that begin with an underscore when indexing offline**
If checked, files or directories that begin with an underscore will be excluded.

## Languages and Stemming

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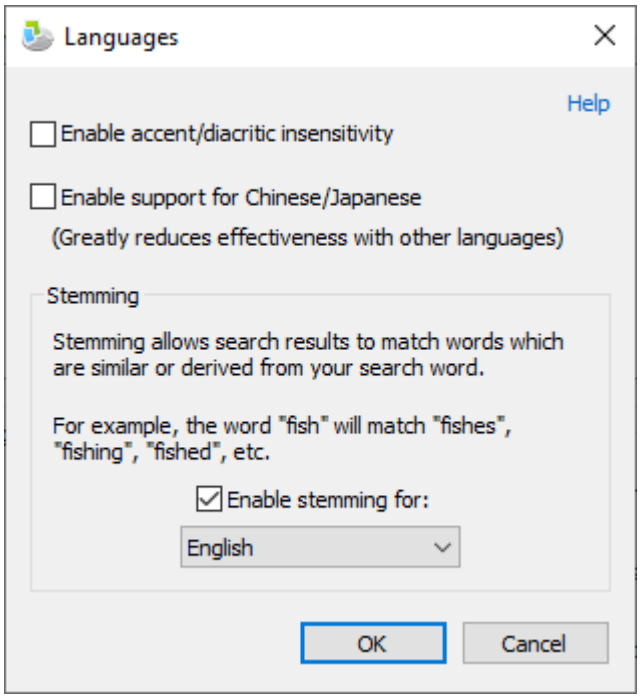


## Accent/diacritic insensitivity

This will map all occurrences of accented characters to their non-accented equivalent (eg. ó, ò, ô, etc. will all be treated as “o”). With this enabled, a user can enter the search word “cliché” and it will find all occurrences of the word on your website spelt as either “cliché” or “cliche".

## Support for Chinese/Japanese

Enabling this feature will ignore space delimiting rules (important for Latin based languages) that typically helps when matching against Asian languages such as Chinese and Japanese. However note that this greatly reduces effectiveness when searching with English and other Latin-based languages. It is advised to create a separate index with this setting enabled if you need to search for both types of languages.

## Stemming

Stemming refers to similar words that derived from search terms. For example, searches for "fish" would return results for "fishing", "fishes", and "fished". To enable stemming, check the 'Enable stemming for:' checkbox and select a language.

### Binary String Extraction

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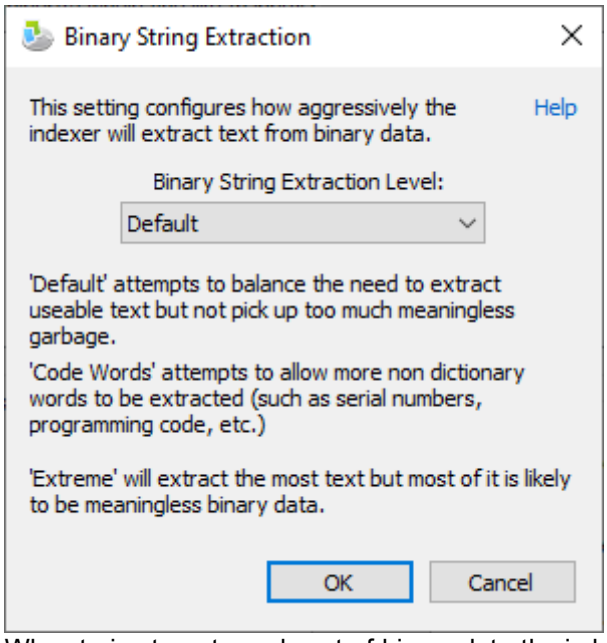
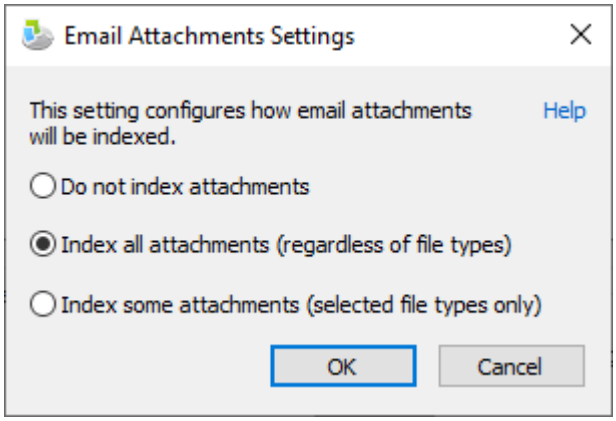



When trying to get words out of binary data the indexing process has to make a decision as to what is a word and what is just random data.

Changing this option will determine how lenient/strict the indexer is when making this decision. Generally leaving this on default, the most strict option, is recommended as this will aggressively remove nonsense data a keep the index to a more manageable size. The Code Words setting is useful if you are trying to find things like passwords missed by the default option. The Extreme option will pull out a lot of data, much of which will be nonsense, in most cases this option will not be needed.

## Email Attachments




Changing the option determines if/all/some emails attachments are indexed.

## Custom Indexing Limits

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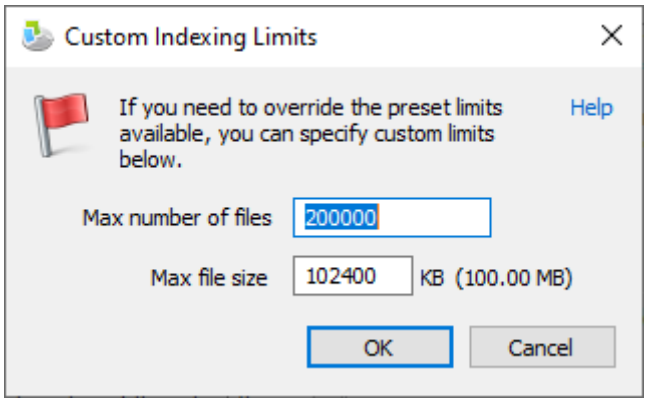


Limits allow users to manually configure indexing limits, which may need to be done in special cases. To enable custom limits, check the 'Enable Custom Limits' checkbox.

**Max. files to index**
Maximum number of files to scan and include in the index

**Max. file size indexed**
Maximum file size that can be indexed, This limit does not apply directly to containers such are zip and mail files (but does apply to the files extracted from within them).

#### 5.16.1.4 RAM drive

By selecting the option to "Use a RAM drive" during the "Create Index" process, you allow OSF to create a drive in memory which is faster than any SSD or HDD.

This replaces the typical use of a "swap drive" for temporary files used during the indexing process (for example when a ZIP file is unzipped to access its contents). By writing, reading and deleting files in RAM, we achieve the highest speed and lowest latency possible when indexing certain file types such as ZIP files, and email attachments.

### System Requirements

When enabled, depending on the amount of memory available, the indexer will allocate a minimum 1 GB of memory for the RAM drive. If the indexing computer has more than 16 GB of memory available, it will double the size of the RAM drive, incrementing up to a maximum 8 GB RAM drive when a computer has more than 48 GB of memory available.

### What to expect

Besides significantly faster indexing for certain file types and higher memory usage, you will notice a new drive letter on your indexing computer under "Windows Explorer" or similar (e.g. "E:") with a volume name of "OSF_TEMP".

When indexing is completed, this drive will be dismounted and removed.

If you are indexing from multiple instances of OSForensics at the same time, then each will get its own RAM drive (with a different drive letter).

### Troubleshooting

While we have done our utmost to ensure the indexing happens seamlessly and without problems, indexing can be a long and complicated process involving massive amounts of data, so there is the possibility that something can go wrong. If the indexer crashes or does not complete properly, there is

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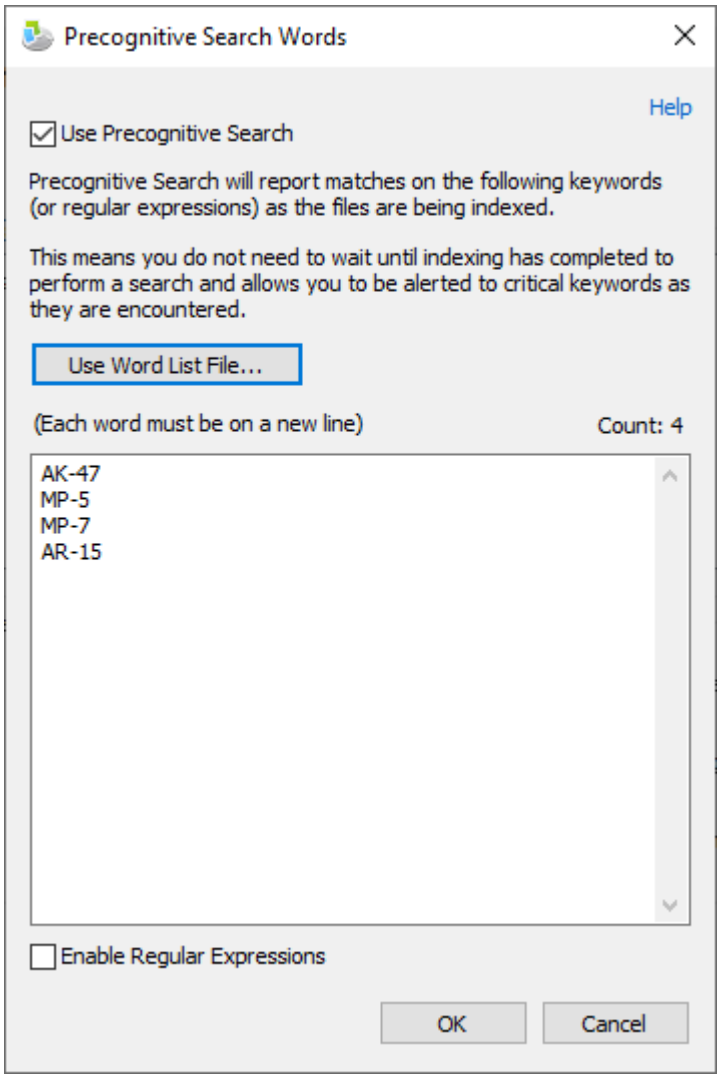
a chance the RAM drive will remain after an indexing session and you have already closed OSForensics.

Should this happen, simply restart OSF and it will notice this stray RAM drive and clean up properly. If it still remains, then rest assured that restarting your computer will also remove the RAM drive.

Note that there is no permanent effect from using a RAM drive. By its nature, everything done in RAM is erased when a computer is switched off or restarted.

#### 5.16.1.5 Precognitive Search




Precognitive Search allows you to enter a list of up to 400 keywords (or regular expressions) that will be checked against during the indexing process.

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This means that instead of waiting until the index is fully built before you can perform a search, you can now get results hours or even days earlier. This allows you to start your investigation while the indexing process continues in the background.

Click on the "Use Word List File..." button to import a list of words from a text file.

Note that only 400 keywords are supported, as a longer list would slow down indexing to the point where it would be more time effective to complete indexing before performing such an extensive search. The same Word Lists can be used in the "Search Index" module.

**Enable Regular Expressions**
Check this option to enable the use of Regular Expressions in the word list above. The regular expression syntax supported for this feature is ECMAScript.

Regular Expression can be very powerful but also very complex. There are many comprehensive references and tutorials for ECMA syntax Regular Expressions online which we would advise referencing for a more complete guide. We have included a brief Quick Reference for ECMA Regular Expression here.

## Show Precog Results

Once you have specified your Precog keywords, and you have proceeded with indexing, you will notice a "Show Precog Results" button on the Indexing Status window. Click on this button to display the matches being found during indexing. You can double click on any file to open the file in the Internal Viewer.

5.16.1.5.1 ECMA Regular Expressions

This is a quick reference for the Regular Expression syntax used by the Precognitive Search function in the Indexing module.

*PLEASE NOTE: The Raw Disk Viewer uses a different (PCRE) regular expression syntax. For more information on the syntax used by the Raw Disk Viewer, please click here.*

## Quick Reference for ECMAScript Regular Expression

SPECIAL PATTERN CHARACTERS
Special pattern characters are characters (or sequences of characters) that have a special meaning when they appear in a regular expression pattern, either to represent a character that is difficult to express in a string, or to represent a category of characters. Each of these *special pattern characters* is matched in the target sequence against a single character (unless a quantifier specifies otherwise).

| characters | description | matches |
|---|---|---|
| . | not newline | any character except *line terminators* (LF, CR, LS, PS). |
| \t | tab (HT) | a horizontal tab character (same as \u0009). |
| \n | newline (LF) | a newline (line feed) character (same as \u000A). |
| \v | vertical tab (VT) | a vertical tab character (same as \u000B). |
| \f | form feed (FF) | a form feed character (same as \u000C). |

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| characters | description | matches |
|---|---|---|
| **\r** | carriage return (CR) | a carriage return character (same as **\u000D**). |
| **\c***letter* | control code | a control code character whose *code unit value* is the same as the remainder of dividing the *code unit value* of *letter* by 32.<br>For example: \ca is the same as \u0001, \cb the same as \u0002, and so on... |
| **\x***hh* | ASCII character | a character whose *code unit value* has an hex value equivalent to the two hex digits *hh*.<br>For example: \x4c is the same as L, or \x23 the same as #. |
| **\u***hhhh* | unicode character | a character whose *code unit value* has an hex value equivalent to the four hex digits *hhhh*. |
| **\0** | null | a null character (same as **\u0000**). |
| *****int* | backreference | the result of the submatch whose opening parenthesis is the *int*-th (*int* shall begin by a digit other than 0). See groups below for more info. |
| **\d** | digit | a decimal digit character (same as **[[:digit:]]**). |
| **\D** | not digit | any character that is not a decimal digit character (same as **[^[:digit:]]**). |
| **\s** | whitespace | a whitespace character (same as **[[:space:]]**). |
| **\S** | not whitespace | any character that is not a whitespace character (same as **[^[:space:]]**). |
| **\w** | word | an alphanumeric or underscore character (same as **[_[:alnum:]]**). |
| **\W** | not word | any character that is not an alphanumeric or underscore character (same as **[^_[:alnum:]]**). |
| *****character* | character | the character *character* as it is, without interpreting its special meaning within a regex expression.<br>Any *character* can be escaped except those which form any of the special character sequences above.<br>Needed for: ^ $ \ . * + ? ( ) [ ] { } \| |
| **[***class***]** | character class | the target character is part of the class (see character classes below) |
| **[^***class***]** | negated character class | the target character is not part of the class (see character classes below) |

QUANTIFIERS

Quantifiers follow a character or a *special pattern character*. They can modify the amount of times that character is repeated in the match:

| characters | times | effects |
|---|---|---|
| ***** | 0 or more | The preceding atom is matched 0 or more times. |
| **+** | 1 or more | The preceding atom is matched 1 or more times. |
| **?** | 0 or 1 | The preceding atom is optional (matched either 0 times or once). |
| **{***int***}** | *int* | The preceding atom is matched exactly *int* times. |
| **{***int***,}** | *int* or more | The preceding atom is matched *int* or more times. |
| **{***min***,***max***}** | between *min* and *max* | The preceding atom is matched at least *min* times, but not more than *max*. |

By default, all these quantifiers are greedy (i.e., they take as many characters that meet the condition as possible). This behavior can be overridden to *ungreedy*

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(i.e., take as few characters that meet the condition as possible) by adding a *question mark* (?) after the quantifier.
For example:
Matching "(a+).*" against "aardvark" succeeds and yields aa as the first submatch.
While matching "(a+?).*" against "aardvark" also succeeds, but yields a as the first submatch.

GROUPS
Groups allow to apply quantifiers to a sequence of characters (instead of a single character). There are two kinds of groups:

| characters | description | effects |
|---|---|---|
| **(***subpattern***)** | Group | Creates a backreference. |
| **(?:***subpattern***)** | Passive group | Does not create a backreference. |

When a group creates a backreference, the characters that represent the *subpattern* in the target sequence are stored as a *submatch*. Each submatch is numbered after the order of appearance of their opening parenthesis (the first submatch is number 1, the second is number 2, and so on...).

ASSERTIONS
Assertions are conditions that do not consume characters in the target sequence: they do not describe a character, but a condition that must be fulfilled before or after a character.

| characters | description | condition for match |
|---|---|---|
| **^** | Beginning of line | Either it is the beginning of the target sequence, or follows a *line terminator*. |
| **$** | End of line | Either it is the end of the target sequence, or precedes a *line terminator*. |
| **\b** | Word boundary | The previous character is a *word character* and the next is a *non-word character* (or vice-versa).<br>Note: The beginning and the end of the target sequence are considered here as *non-word characters*. |
| **\B** | Not a word boundary | The previous and next characters are both *word characters* or both are *non-word characters*.<br>Note: The beginning and the end of the target sequence are considered here as *non-word characters*. |
| **(?=***subpattern***)** | Positive lookahead | The characters following the assertion must match *subpattern*, but no characters are consumed. |
| **(?!***subpattern***)** | Negative lookahead | The characters following the assertion must not match *subpattern*, but no characters are consumed. |

ALTERNATIVES
A pattern can include different alternatives:

| character | description | effects |
|---|---|---|
| **\|** | Separator | Separates two alternative patterns or subpatterns. |

A regular expression can contain multiple alternative patterns simply by separating them with the *separator operator*(**|**): The regular expression will match if any of the alternatives match, and as soon as one does.

Subpatterns (in groups or assertions) can also use the *separator operator* to separate different alternatives.

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CHARACTER CLASSES

A character class defines a category of characters. It is introduced by enclosing its descriptors in square brackets ([ and ]).
The regex object attempts to match the entire character class against a single character in the target sequence (unless a quantifier specifies otherwise).

The character class can contain any combination of:

- **Individual characters:** Any character specified is considered part of the class (except the characters **\, [, ]** and **-** when they have a special meaning as described in the following paragraphs).
  For example:
  `[abc]` matches `a`, `b` or `c`.
  `[^xyz]` matches any character except `x`, `y` and `z`.

- **Ranges:** They can be specified by using the *hyphen character* (-) between two valid characters.
  For example:
  `[a-z]` matches any lowercase letter (`a`, `b`, `c`, ... until `z`).
  `[abc1-5]` matches either `a`, `b` or `c`, or a digit between `1` and `5`.

- **POSIX-like classes:** A whole set of predefined classes can be added to a custom character class. There are three kinds:

| class | description |
|---|---|
| **[:***classname***:]** | character class |
| **[.***classname***.]** | collating sequence |
| **[=***classname***=]** | character equivalents |

The choice of available classes depend on the regex traits type and on its selected locale. But at least the following character classes shall be recognized by any regex traits type and locale:

| class | description |
|---|---|
| [:alnum:] | alpha-numerical character |
| [:alpha:] | alphabetic character |
| [:blank:] | blank character |
| [:cntrl:] | control character |
| [:digit:] | decimal digit character |
| [:graph:] | character with graphical representation |
| [:lower:] | lowercase letter |
| [:print:] | printable character |
| [:punct:] | punctuation mark character |
| [:space:] | whitespace character |
| [:upper:] | uppercase letter |
| [:xdigit:] | hexadecimal digit character |
| [:d:] | decimal digit character |
| [:w:] | word character |
| [:s:] | whitespace character |

Please note that the brackets in the class names are additional to those opening and closing the class definition.
For example:
`[[:alpha:]]` is a character class that matches any alphabetic character.
`[abc[:digit:]]` is a character class that matches `a`, `b`, `c`, or a digit.

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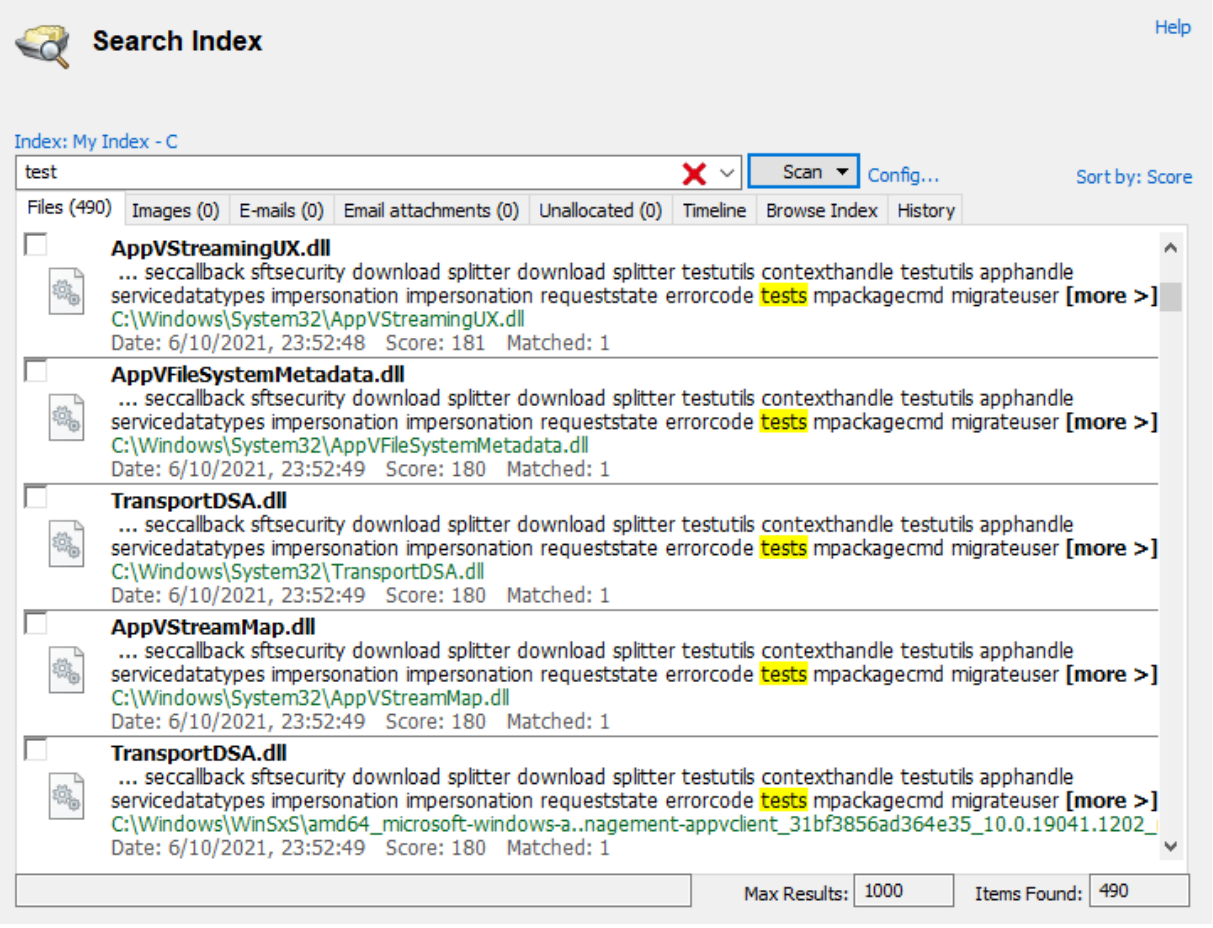
`[^[:space:]]` is a character class that matches any character except a whitespace.

- **Escape characters:** All escape characters described above can also be used within a character class specification. The only change is with \b, that here is interpreted as a backspace character (\u0008) instead of a word boundary. Notice that within a class definition, those characters that have a special meaning in the regular expression (such as *, ., $) don't have such a meaning and are interpreted as normal characters (so they do not need to be escaped). Instead, within a class definition, the hyphen (-) and the brackets ([ and ]) do have special meanings under some circumstances, in which case they should be placed within the class in other locations where they do not have such special meaning, or be escaped with a backslash (\).

### 5.16.2 Search Index

The Search Index module performs the actual search using the index generated via the Create Index module. Unlike the File Name Search, the contents of the file are searched (as opposed to just the filename or other file attributes) for the user-specified search words.




## Usage

To perform a search, first select an index or multiple indices to search. Multiple indices can be specified by selecting *Multiple Index Search Options* link in the *Index* link drop-down menu. Next, simply enter one or several words and click search. More advanced searching criteria is detailed below.

## Search Criteria

**Any or All Search Words**
You can select to search for either any or all of the entered words from the Advanced Search Options (accessed by clicking on the *Config...* link).

**Wildcards**
You can use wildcard characters '*' and '?' in your search terms to search for multiple words and return larger set of results. An asterisk character ('*') in a search term represents any number of characters, while a question mark ('?') represents any single character.

This allows you to perform advanced searches such as "zoom*" which would return all pages containing words beginning with "zoom". Similarly, "z??m" would return all pages containing four letter words beginning with 'z' and ending with 'm'. Also, "*car*" would be a search for any words containing the word "car".

**Exact phrase**
An exact phrase search returns results where the phrase of words are found, in the same order that they are specified. For example, an exact phrase search for the words "green tea" would only return results where the phrase 'green tea' appears. It would not return pages where the words 'green' and 'tea' are found separately, or in a different order such as, 'tea green'.

To specify an exact phrase search term, you need to enclose the words that form the phrase using double quotation marks. You can also combine the use of exact phrase searches with normal search terms and wildcard search terms within a single search query (eg. "green tea" japan*). Note however, that wildcards within exact phrases (eg. "green te*") are not supported.

**Exclusion/negative searches**
You can precede a search term with a hyphen character to exclude that search term from being included in your search results. For example, a search for "cat -dog" would return all pages containing the word "cat" but not the word "dog".

## Use Word List File

A Word List File allows the user to specify a file containing a list of terms to search for in the currently selected index. This effectively performs a bulk search on the list of terms automatically. Results from the bulk search will appear in the History View from where they can be opened and viewed.

The word list file should place each search on a new line. Lines starting with # are comment lines and will not be searched. A double # at the beginning of a line can be used if you actually need the search term to start with a #. Example search word lists have been provided and will appear in the default directory when selecting a file. For easy access it is recommended you put your own search word list files in this same directory.

# Results

The results of the index search are displayed in the tabbed view, organized into file types. See Index Search Results View for more details.

### 5.16.2.1 Search Index Configuration

The Search Index Configuration Window allows users to configure various search parameters. This window can be accessed by clicking on the "Advanced" button in the main Search Index window.

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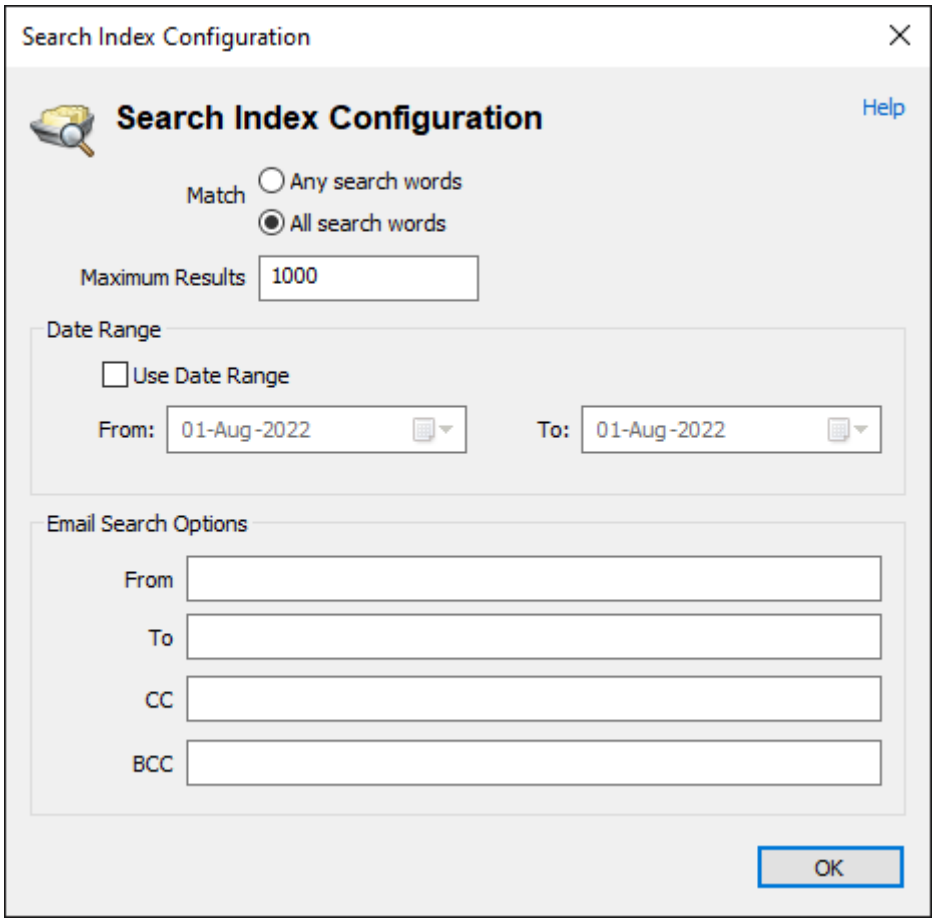



**Match**
The user can select whether the results will match any of the words or all of the words in the search string

**Maximum Results**
Specifies the maximum number of results to display

**Date Range**
If 'Use Date Range' is checked, allows the user to filter the results to include only files within the specified date range.

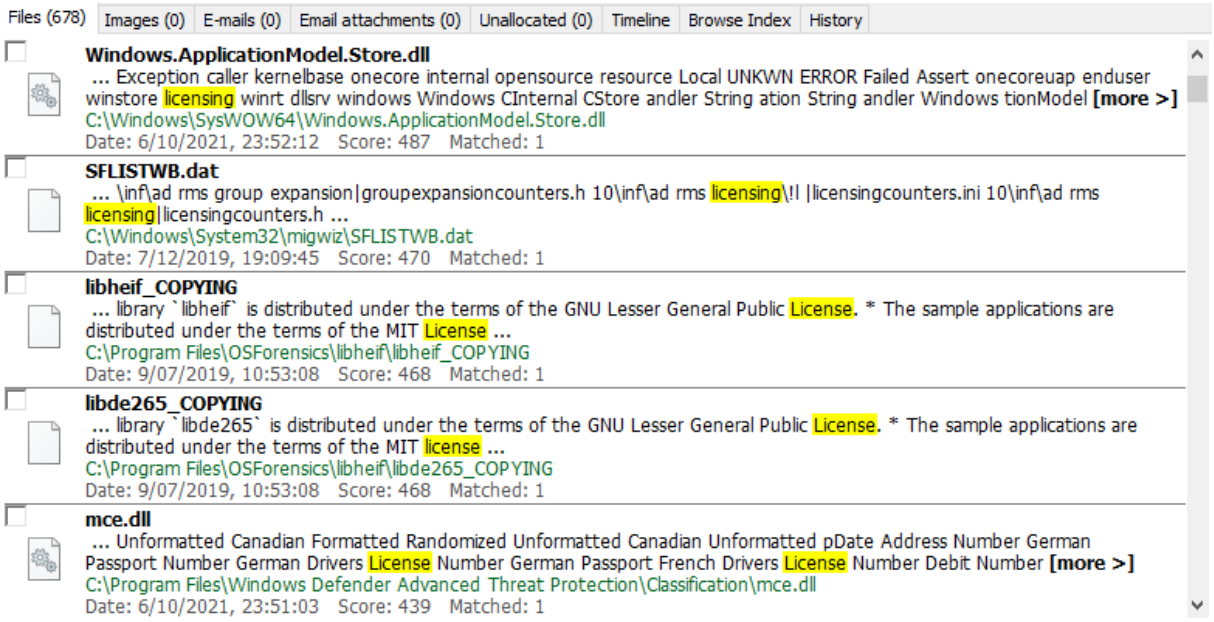
**Email Search Options**
Allows the user to filter the e-mail search results to those matching the 'From', 'To' and 'CC' fields

### 5.16.2.2 Index Search Results View

After an index search is performed, the results are displayed in the Results View. The results are organized into several views, depending on the file type.

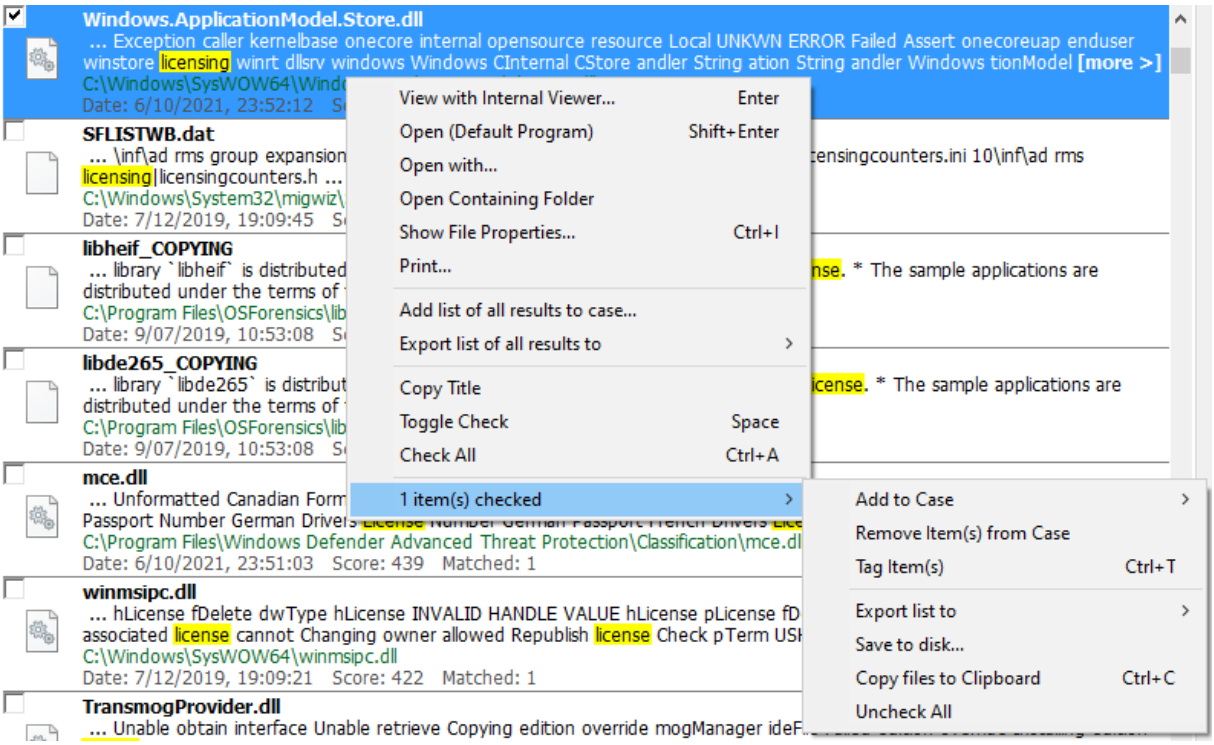
## Types of Views

### Files View




The File View displays the search results as a list of file names, along with its corresponding metadata, icon, score and the number matched. The score ranks the relevancy of the search string with the file.The results are sorted according to the criteria selected in the Sorting combo box.

Right-clicking a file opens the following context menu. Certain actions may or may not be available depending on the current results tab.




**View with Interval Viewer**
Opens the file with OSForensics Viewer to perform a more thorough analysis

**Open (Default Program)**
Open the file with the default program.

**Open With...**
Allows the user to select the program to open the file

**Open Containing Folder**
Opens the folder than contains the file

**Show File Properties**
Opens the file with OSForensics Viewer in File Info mode.

**Print...**
Print the file (if applicable)

**Add Results to Case...**
Add the list of results as an HTML or CSV file to case

**Export Results to**
Export the list of results to a TXT, CSV or HTML file

**Copy Title**
Copy the title to clipboard

**Toggle Check**
Toggle the check state of the selected item.

**Check All**
Check all the items in the list.

**n Item(s) checked**

**Add to Case**
Add the checked file(s) or list of checked file(s) to the case, see Adding items to a case.

**Remove Item(s) from Case**
Remove the checked file(s) from the case

**Tag Item(s)**
Tag file(s) for future reference. *Keyboard shortcut: Ctrl+T*

**Export list to**
Export the list of checked file(s) to a TXT, CSV or HTML file

**Save to disk...**
Save the checked file(s) to disk. Note that files within another file (such as files within ZIP files or emails and attachments within PST files) will save the container file to disk.

**Copy File(s) to Clipboard**
Copy the checked file(s) to clipboard. Once copied to the clipboard, the file(s) can be pasted to any other application that supports it (eg. Windows Explorer).

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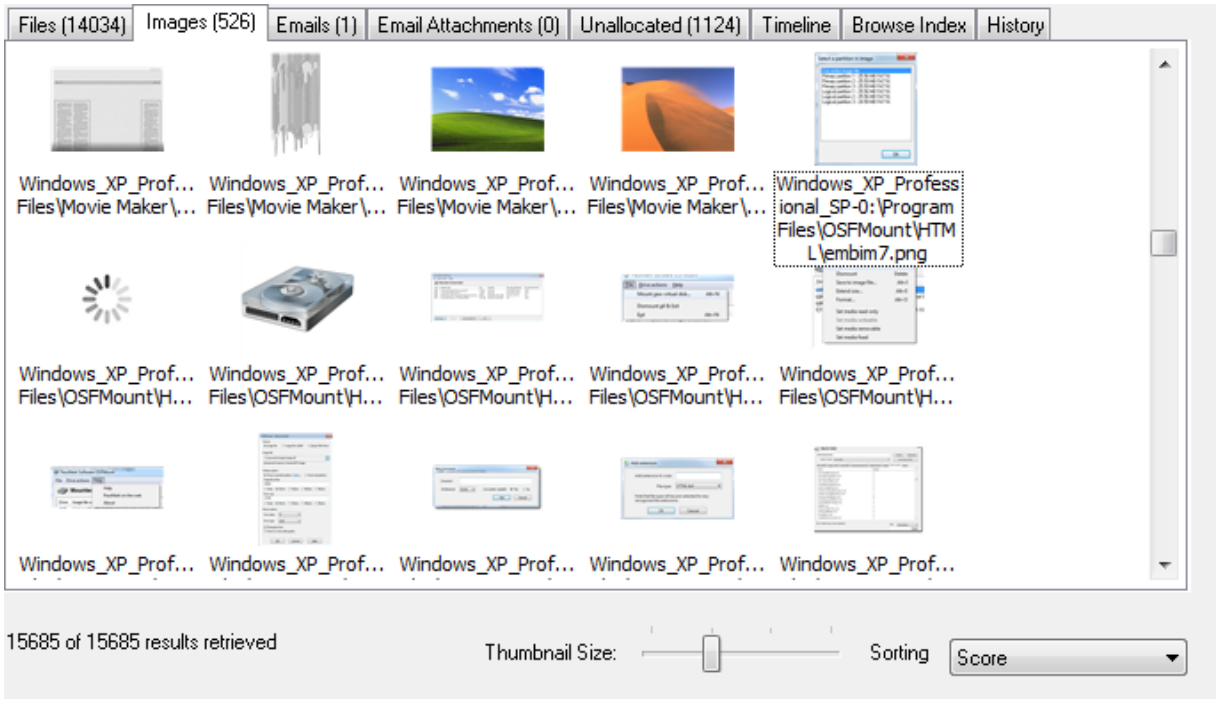
*Note: In some cases, copy and pasting files to an explorer window may fail without an error message when "preparing to copy". This may happen if the file has already been deleted (eg a temp file) or if Windows Explorer does not have permissions to access the files (eg restricted system files and folders). In these cases, it is better to use the "Add to case" function.*

## Images View




The Images View displays only the search results that contain images as a list of thumbnails. This view is useful when the search results contain media files, allowing the user to quickly browse through the thumbnail images. Similar to the File View, the results can be sorted via the Sorting combo box. The size of the thumbnails can be adjusted using the Thumbnail Size slider bar.

## Email View

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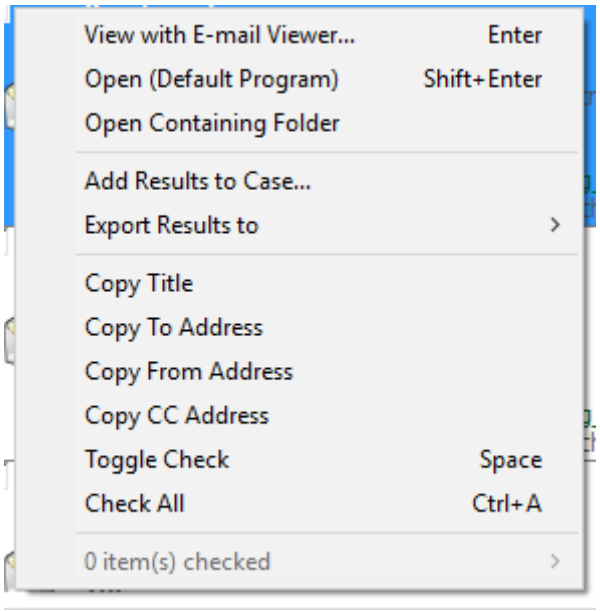
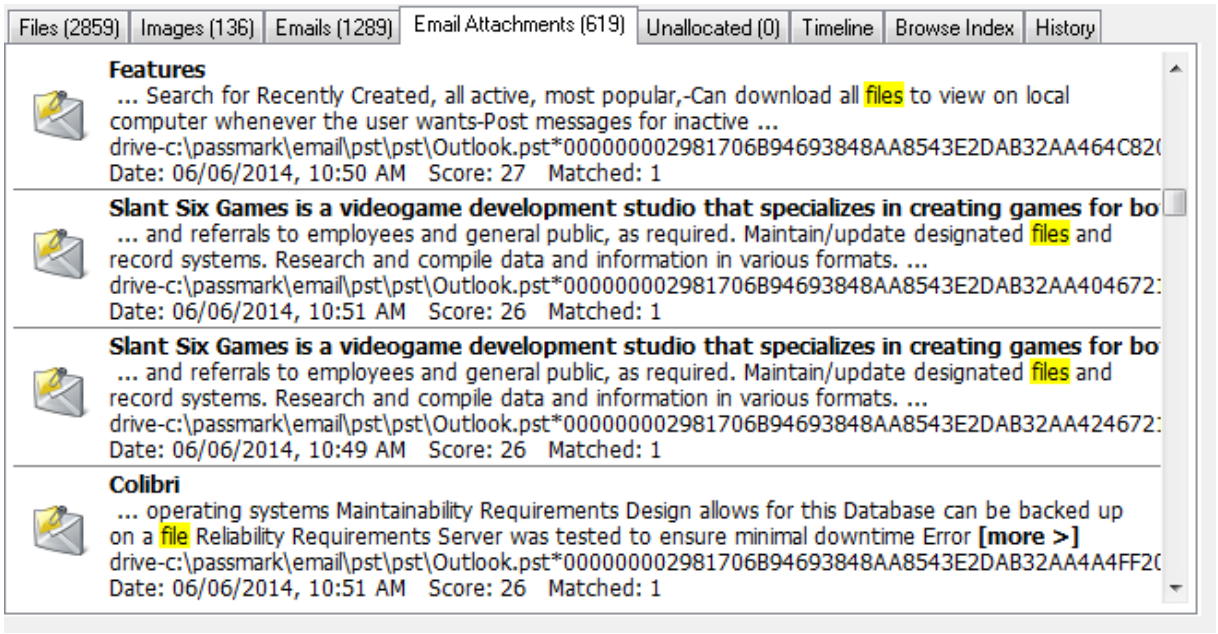
The Email View displays a list of e-mail results. This view displays results containing specific e-mail metadata, such as a preview of the message body, and various e-mail header fields (eg. From, To, CC). Double clicking on an e-mail opens the E-mail Viewer window. Right-clicking an e-mail opens the following context menu:



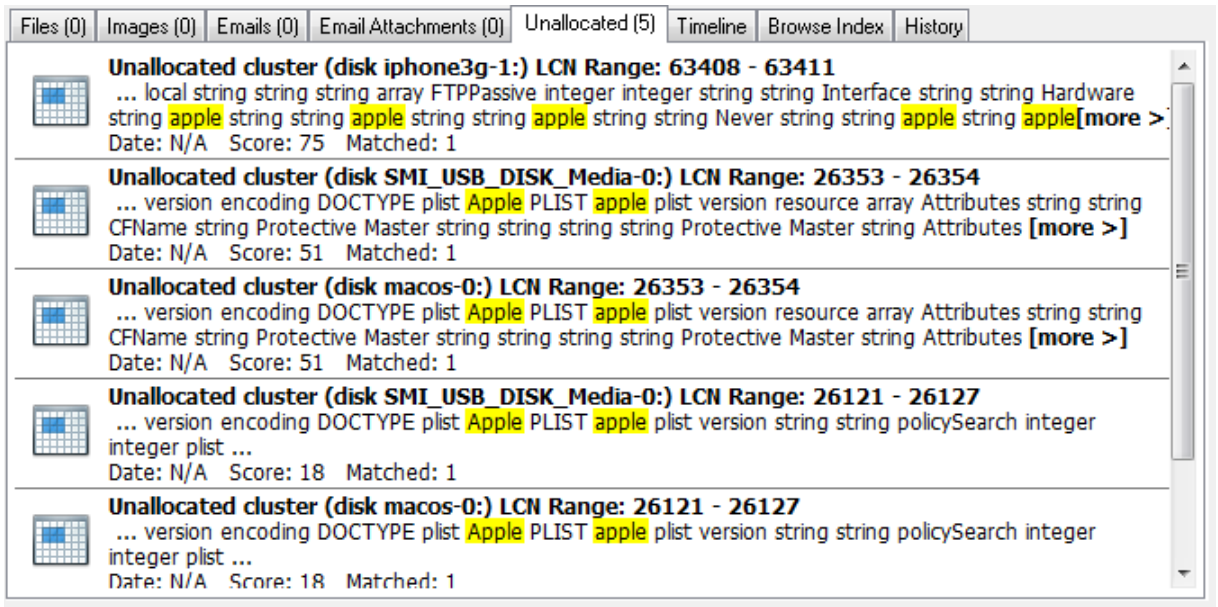

**Copy To / From / CC Address**
For emails you can copy any of the addresses associated with it.

## Email Attachments View




The Email Attachments View displays a list of attachment files that were found within e-mails. Double clicking on an e-mail opens the E-mail Viewer window.

## Unallocated View




The Unallocated View displays a list of unallocated cluster (free clusters not allocated to any file) results. The results contain the LCN range, along with any contained text if applicable. Double clicking on a cluster range opens the Internal Viewer.

## Timeline View

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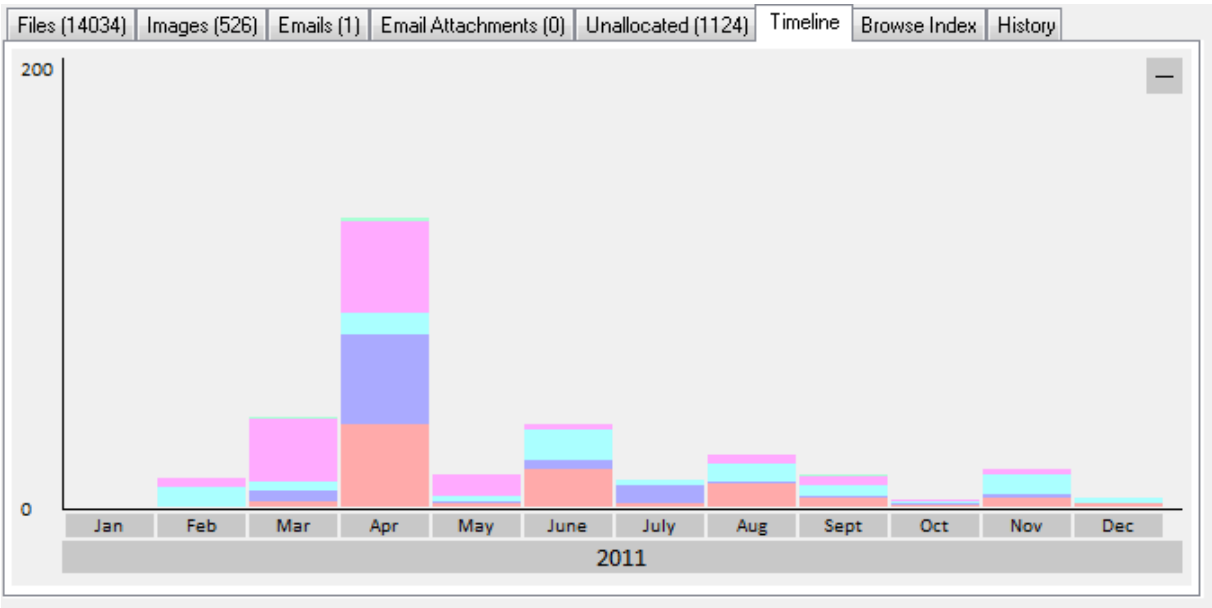
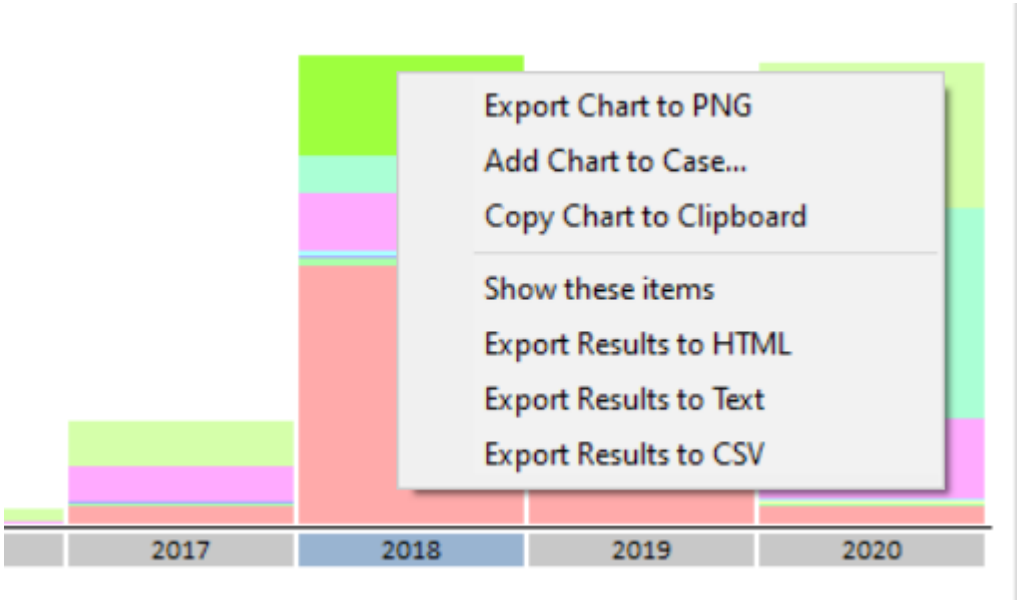



The Timeline View displays an interactive bar graph providing the user with a visual view of the distribution of the search results with respect to the modified dates of the files. The granularity of the scale can be adjusted by clicking on the bar graphs to zoom in or the '-' button on the top-right corner to zoom out. Right-clicking a bar section brings up the following menu:




**Show these files**
Filter the search results to show only those that belong to the selected time bar

**Export to HTML**
Export the results contained in the highlighted bar to HTML

**Export to Text**
Export the results contained in the highlighted bar to text

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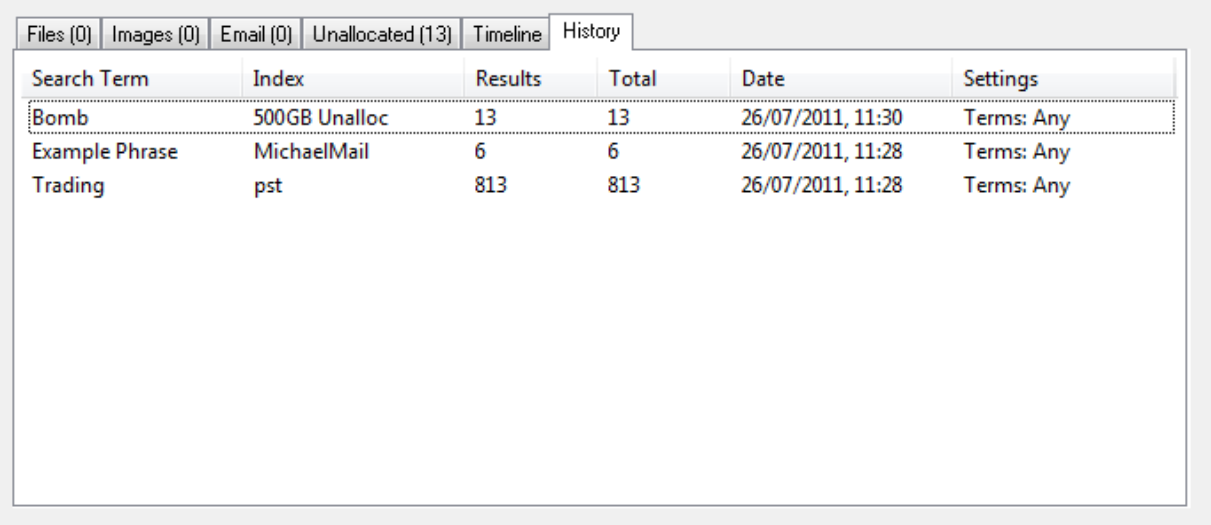
**Export to CSV**
Export the results contained in the highlighted bar to CSV

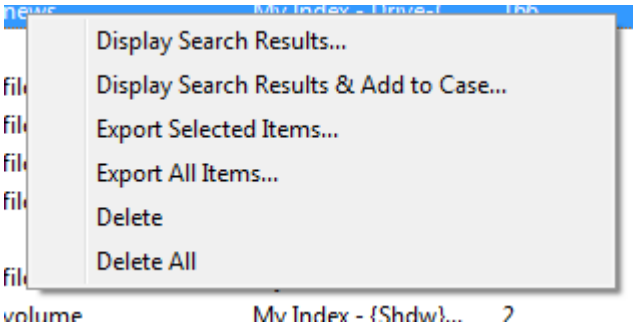
## Browse Index View

The Browse Index View shows the list of words, text and strings found when the index was created. For more information, see Browse Index.

## History View




The History View keeps a history of all index searches performed for the case. This allows previous searches to be logged so that they can be repeated if necessary. Loading previous search results from history is much faster than doing the searches again. Additionally, when the user performs a search using a Word List, the results are displayed in the History View. Right-clicking a previous search brings up the following menu:




**Display Search Results**
Display the results of the selected previous search

**Search For Selected Items & Add To Case**
Display the results of the selected previous search(es), and add all files contained in the results to case

**Export Selected Items...**
Export the list of selected history items to a CSV file.

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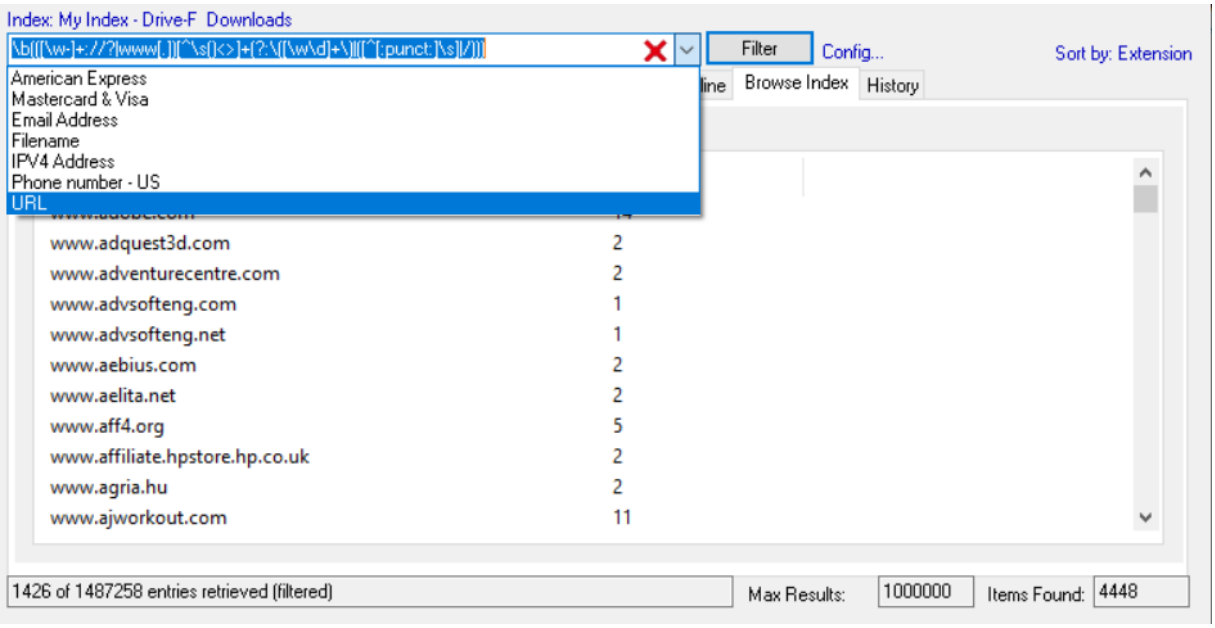
**Export All Items...**
Export the entire list of history items to a CSV file.

**Delete**
Delete the selected history item(s)

**Delete All**
Delete all history items in the list

### 5.16.2.3 Browse Index

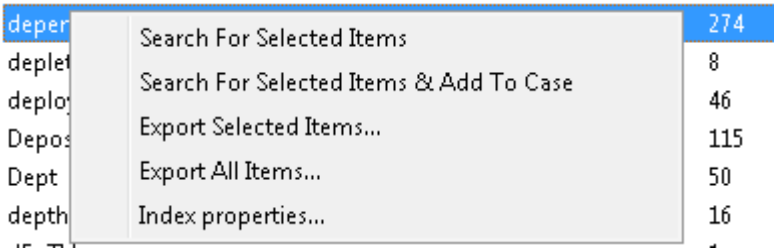
The "Browse Index" tab allows the investigator to examine the actual index itself, which is a list of words, text and strings found when the index was created. It will list all the words in alphabetically ascending order. The main purpose of analyzing the index contents is to look for recognizable strings such as e-mail addresses, phone numbers, credit card numbers, IP addresses and more.




# Usage

## Right-click Menu

Right-clicking an index word opens the following context menu. Certain actions may or may not be available depending on the current results tab.




**Search For Selected Items**

Performs the search on the selected item(s) and save the results in History View.

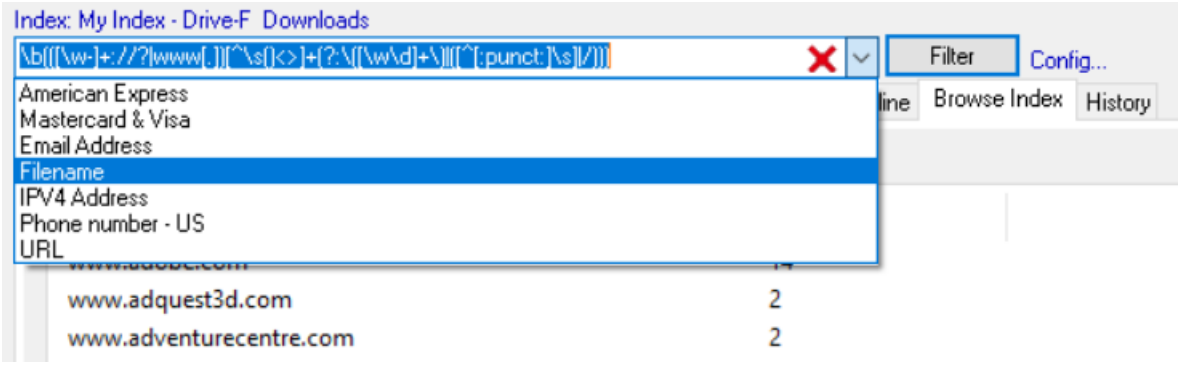
**Search For Selected Items & Add To Case**
Performs the search on the selected item(s), save the results in History View and add the results to case.

**Export Selected Items...**
Export the list of selected items to a CSV file.

**Export All Items...**
Export the entire list of words to a CSV file.

**Index properties...**
Shows the details of the index including number of files indexed, total size and number of unique words.

## Filtering Index Strings




Regular expressions are used to filter the list of strings. There are several predefined regular expressions that can be selected in the search bar drop-down box. The user may also specify their own regular expressions in the search box.

**Predefined Regular Expressions**

Predefined regular expressions can be selected in the search bar drop-down box. The source of the actual regular expressions used can be found in the *RegularExpressions.txt* file in the OSForensics program data directory (ProgramData\PassMark\OSForensics). These have been collected from various sources and are kept as simple as possible while still returning fairly accurate results, please note these will not be 100% accurate in all situations.

**User-Specified Regular Expressions**

The investigator can specify their own regular expression pattern to filter the list of strings. For example, to search for any entry containing the word "test", type "test" in the search box and then click the *Filter* button. To find only entries that begin with the word "test" use "^test", the "^" character is used to indicate the pattern match must start at the beginning of the found word. For a basic overview of regular expressions, see Regular Expressions.

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## 5.17 Installing to a USB Drive or an Optical Disk

It is possible to install OSForensics portably onto a USB or network drive such that no installation is required on the test system. This can be useful in a number of scenarios, such as field analysis without installing OSForensics on the test system.

When running OSForensics Portable, the default directory for users files is the OSForensics directory, rather than the normal default directory of the users' Document directory.

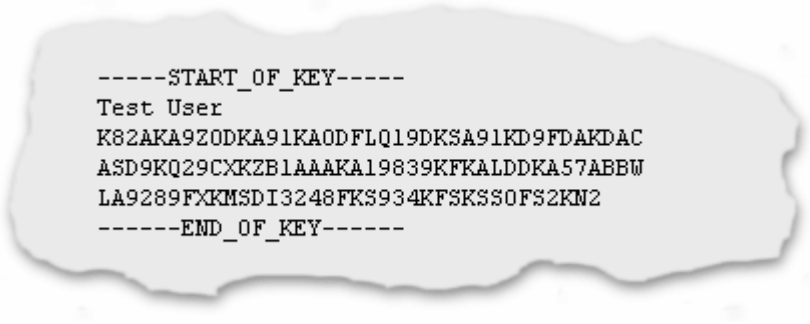
### Installing OSForensics to a USB or Network drive

This installation process can be performed for a USB drive or network share using the menu option "Install to USB or Network".

From the 'Install OSForensics Portable' window, you need to specify:

1. The USB drive or network path you want to install OSForensics Portable. For example, "F:\OSForensics". OSForensics will create the directory if it does not exist.
2. If you have large password recovery dictionaries or large rainbow tables you can choose to exclude them from the USB copy process by unchecking the options.
3. Enter the Username/Key;

Select the entire key, including the -----START_OF_KEY----- and -----END_OF_KEY----- flags.




Copy and paste this key into the username and key field.

When you select install, OSForensics will create the directory on the USB drive (e.g. F:\OSForensics), copy all of the files from the OSForensics directory (e.g. C:\Program Files\OSForensics) to the destination folder (e.g. F:\OSForensics) and install the license information.

### Creating a bootable copy of OSForensics

OSForensics can be configured to start directly from a bootable CD/DVD or USB Flash Drive (UFD), rather than being started from within a machine's operating system. This can be useful when the machine you need to run OSForensics on has an invalid, incompatible or otherwise non-working operating system. To run OSForensics on a machine without a valid operating system, you will need to set up a “Pre-install environment” that allows Microsoft Windows to be booted from a CD/DVD or UFD.

PassMark Software has written a document, Building a Bootable Version of OSForensics using WinPE, to help guide you through setting up a Microsoft Window Pre-install environment (WinPE) environment which includes both Windows and OSForensics on a bootable CD/DVD or UFD. The document also

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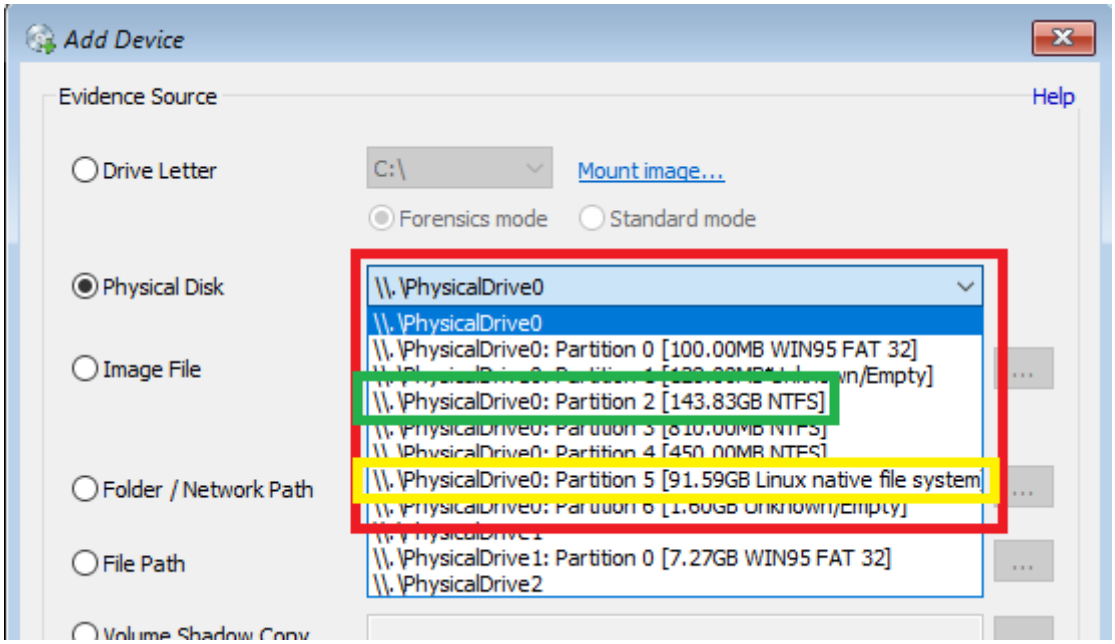
explains how to inject new device drivers into the Windows image for system specific hardware (where required). Alternatively, on the "Install OSForensics to a USB drive" Window, you can check the "Launch PassMark WinPE Builder to Create Bootable Solution" checkbox and follow the following tutorial, Creating a self bootable OSForensics with PassMark WinPE Builder.

## Limitations

- **Create Index:** You will not be able to index some file formats from 64-bit WinPE. This is due to the fact that 64-bit WinPE does not support 32-bit executables, and indexing some file formats require the use of 32-bit components. Instead, we recommend imaging the disk, and performing the indexing from an investigation machine (which should be faster and have more resources than the machine being investigated). This is generally the most practical approach given that indexing is very resource intensive.
- **Disk/Volume Access:** Storage Area Network (SAN) Policy can control whether or not disks are mounted when WinPE is started. When using SAN Policy ***3*** *(Doesn't mount storage devices)* or ***4*** *(Makes internal disks offline, but all external disks and the boot disk are online), the* internal storage locations are not mounted when booting. To process the drives on the system, first add them to the case using "Add Device". The volumes can be added by using the Physical Disk option in Add Devices.




*Note: The Physical Drive listing/order may vary on different systems. Example is shown with different partitions highlighted, does not represent view in OSForensics.*

The Red Box shows the system's main storage, PhyiscalDrive0 with various partitions on the disk.
The Green Box shows the user's installed Windows OS partition, PhyiscalDrive0: Partition 2.
The Yellow Box shows the user's installed Linux OS partition, PhyiscalDrive0: Partition 5.
The WinPE boot USB Flash Drive (UFD) is PhyiscalDrive1. When booting from a WinPE disk, the WinPE image is loaded into RAM Disk and and the volume letter assigned to RAM Disk is X:\. When using option (4), the RAM Disk is still X:\, but the physical UFD and other external storage devices will be assigned drive letters as well, e.g. C:\, D:\, etc.

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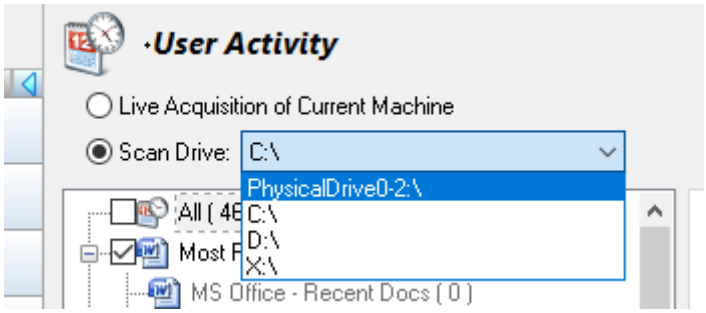
Internal storage devices added to OSForensic using PhysicalDrive access method can be used within the different modules and will be listed in the dropdowns as selectable devices. e.g. User Activity




*C:\ is the UFD, D:\ is SD Card Reader, X:\ is the WinPE RAM Disk and PhysicalDrive0-2:\ is the user/system's Windows OS partition added with "Add Device".*

## 5.18 Internal Viewer

OSForensics includes a built-in viewer for previewing the contents of files, deleted files, memory sections and raw sectors. The internal viewer consists of several viewing modes that aid specifically in forensic data analysis

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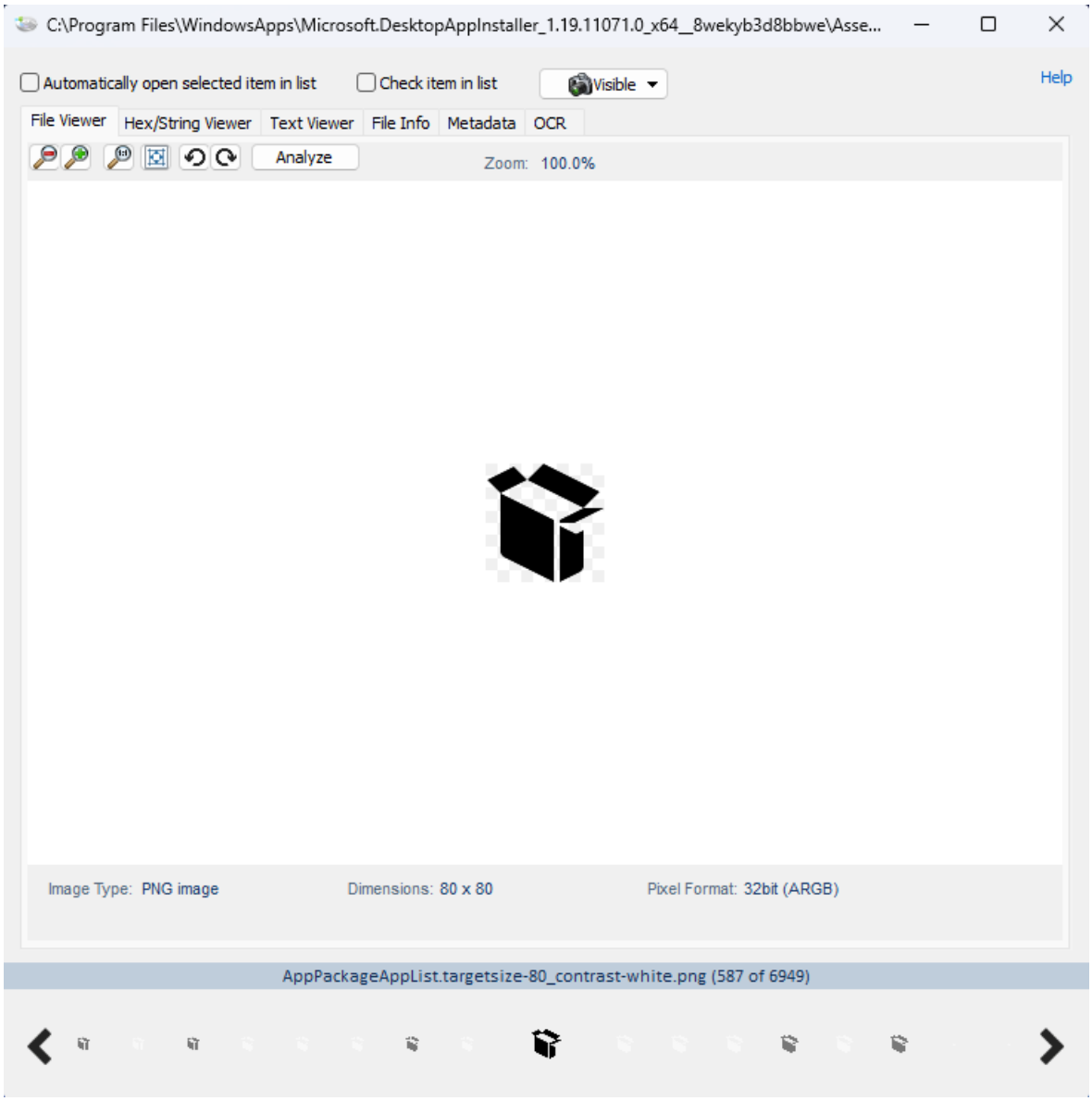


**Automatically open selected item in list**
Allows for the Internal Viewer to synchronize with the file selected in the main window. Allows for fast browsing of images and other documents. No need to reopen the viewer for each image.

**Check item in list**
Checking this option will check the corresponding file in the main window.

**Screenshot (Visible Window, Select Region, Whole Page)**
Takes screenshots in the Internal Viewer - various options in dropdown.

## File Viewer
Previews the data stream as a common file format (ie. image, video, document)

## Hex/String Viewer
Views the data stream as raw bytes (in hex) and extracts any strings contained in the stream

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### Text Viewer
Views the data stream as text

### File Info
Displays the attributes of the data stream

### Metadata
Display the file format specific metadata of the file

### Entropy
Display the entropy of the of the file

### VirusTotal Scan
Scan the file for malicious code using the cloud based VirusTotal API.

To scroll between the items, use the left/right buttons. Optionally, you can double click the previous/next thumbnails or press the left/right keys.

**Keyboard shortcuts**

*Left/Numpad 4 key* - Scroll to previous item

*Right/Numpad 6 key*- Scroll to next item

*Home key* - Scroll to first item

*End key* - Scroll to last item

*Esc key* - Close the internal viewer

*Ctrl-A* - Add file to case

*Space* key - Check item in list

*Minus key* - Reduce the scale of the image

*Plus key* - Increase the scale of the image

*Backslash/Numpad 5* key - Fit image to screen

## 5.18.1 File Viewer

The file viewer attempts to view the data stream as a common file format. The following file formats are supported:

- Image formats (BMP, JPG, GIF, PNG, Exif, and TIFF)
- Video formats
- Audio formats
- Document formats (PDF, DOC, DOCX, XLS, XLSX, PPT, PPTX, RTF, WPD)
- Compressed formats (7z, XZ, BZIP2, GZIP, TAR, ZIP, WIM, AR, ARJ, CAB, CHM, LZH, LZMA, RAR, XAR and Z)

# Image Formats

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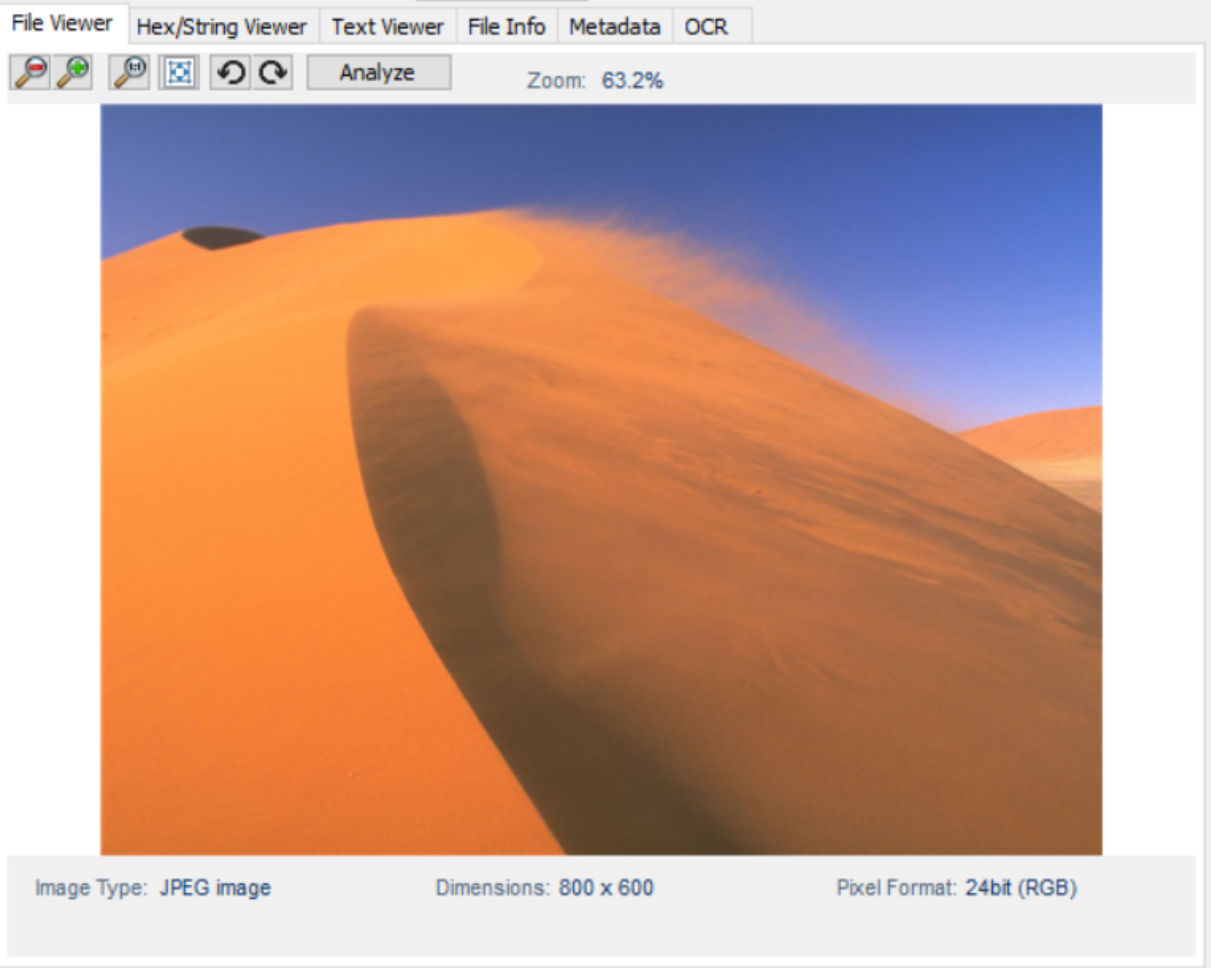


**Zoom**

To zoom on the image, use the buttons on the top left or alternatively, the scroll wheel on the mouse or +/- keys.

**Rotate**
To rotate image, use the rotate buttons on the top left.

**Pan**
To pan the image, use the mouse to drag the image in any direction.

**Analyze**
For more information, see the Image Analysis module.

## Video/Audio Formats

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**Play/Pause**
To play/pause the media file, press the 'Play/Pause' button or click on the image (video only).

**Seek**
To seek within the media file, drag the slider bar to the desired position.

**Rewind**
To seek back to the beginning, press the 'Rewind' button.

**Volume increase/decrease**
To adjust the volume of the audio, use the 'Volume Increase' or 'Volume Decrease' buttons.

## Document Formats

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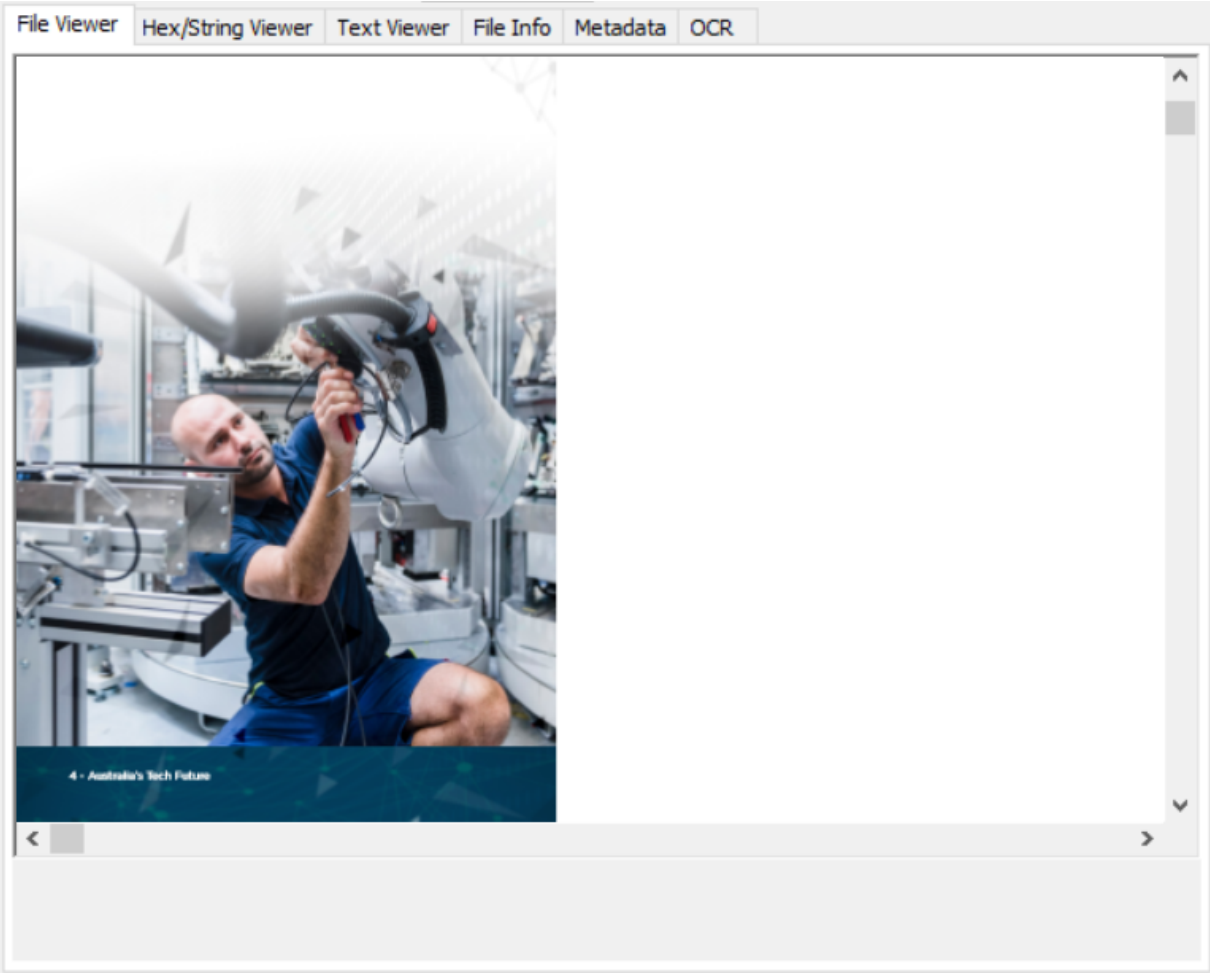


For PDF files, the full document including images and text is rendered. (Windows 8 and later).

For other documents, only the text component of the document file is displayed. Formatting is not preserved.

## Compressed Formats

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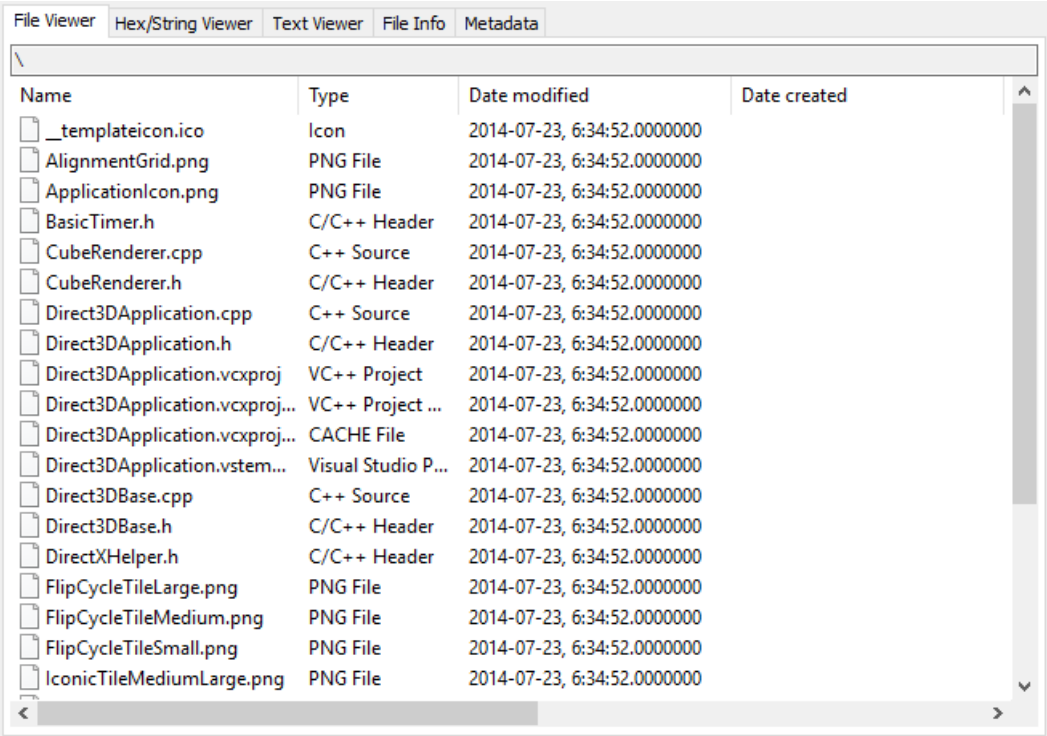


The contents of the compressed file are displayed in a list view. Pressing 'enter' or double-clicking the selected file shall extract and open the file in another OSForensics Viewer window.

### 5.18.2 Hex/String Viewer

The hex/string viewer displays the data stream as raw data bytes in hex. This mode also allows the user to extract ASCII/Unicode strings from the raw data bytes.

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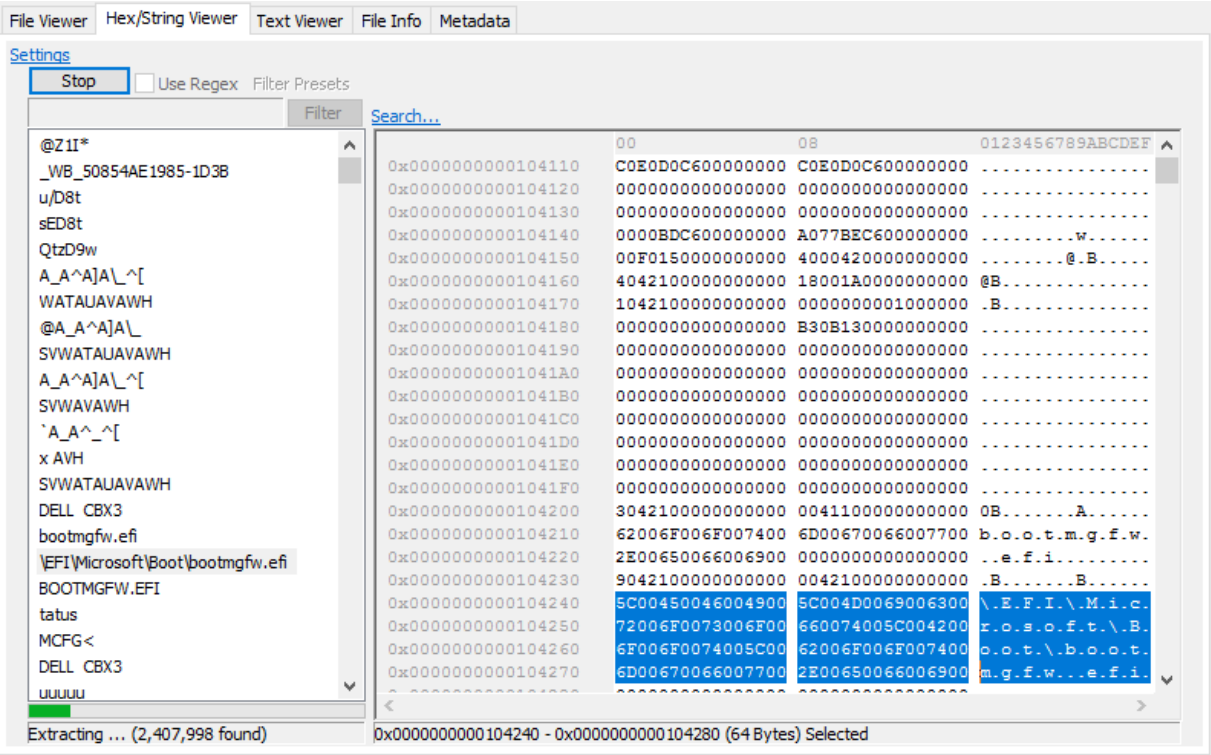
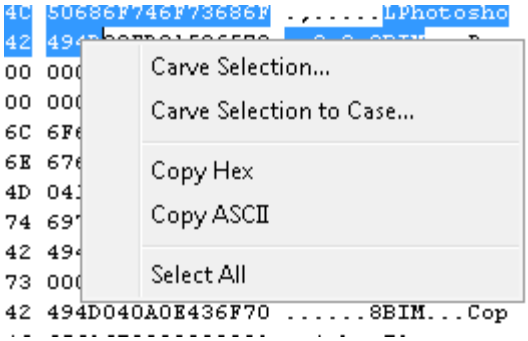



## Hex View

The hex view displays the raw data bytes in hex. The starting offset of each line is identified by hex offset on the left margin. The byte groupings can be configured via the Settings window.

Right-clicking opens a context menu as shown below:




**Carve Selection...**
Carve the selected bytes to file

**Carve Selection to Case...**
Carve the selected bytes to file and add to the case

**Copy Hex**
Copy the selected bytes as hex characters to clipboard

**Copy ASCII**

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Copy the selected bytes as ASCII to clipboard

**Select All**
Select all bytes in the hex viewer

### Hex View Search

Clicking on 'Search...' opens a search window (similar to the Raw Disk Viewer search window) for locating hexadecimal/text patterns.

## String Extraction

Click the 'Extract' button to locate ASCII/Unicode strings in the data stream. Note that for large files, this process may take some time. Advanced string extraction settings can be configured via the Settings window.

The extracted strings are displayed in this list. To filter the results, enter a search string to narrow the results in the string list. This search is case insensitive and is a substring match. Alternatively, the list of strings may be filtered based on a particular string format:

**Filename** - filters all strings that appear to be in a valid filename format

**E-mail** - filters all strings that appear to be in a valid e-mail address format

**URL** - filters all strings that appear to be in a valid URL address format

**GUID** - filters all strings that appear to be in a valid GUID identifier format

**IPv4 Address** - filters all strings that appear to be a valid IPv4 address format

**IPv6 Address (Standard Notation)** - filters all strings that appear to be a valid IPv6 address in standard notation (ie. full 8-word in hexadecimal)

**IPv4 Address (Standard or Compressed Notation)** - filters all strings that appear to be a valid IPv6 address in either standard or compressed notation. Due to the validity of double colons (::) in compressed notation, this regular expression may capture strings that are not IPv6 addresses.

**Date** - filters all strings that appear to be a valid Gregorian date format

**Phone Number (North American)** - filters all strings that appear to be a valid North American phone number

**Use Word List...** - filters all strings that contain any of the words included in the user-specified word list file

Right-clicking opens a context menu as shown below:

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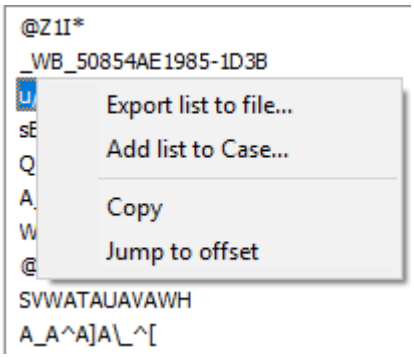



**Export List to file...**
Export the entire string list to a text file

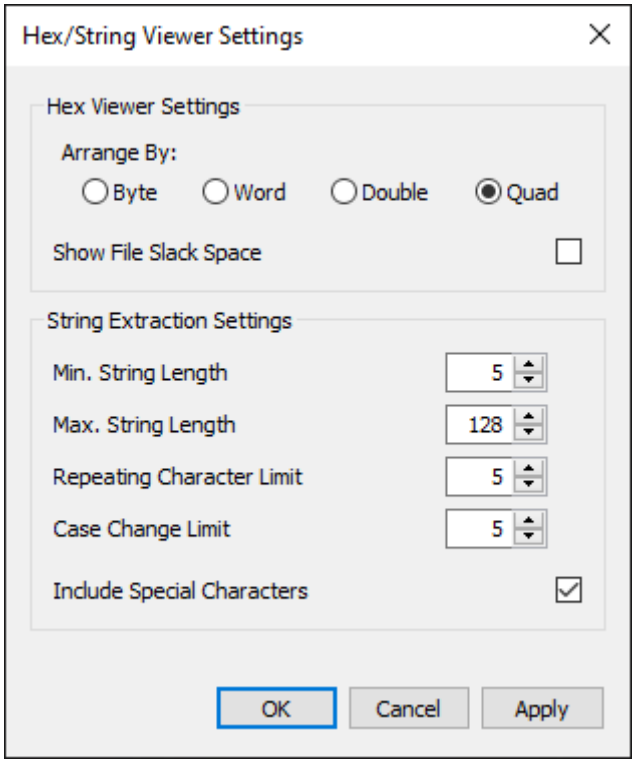
**Add list to Case...**
Save the entire string list to a text file, then add to the case

**Copy**
Copy the string into the clipboard

**Jump to Offset**
Jump to the location of the string in the hex view

### 5.18.2.1 Hex/String Viewer Settings

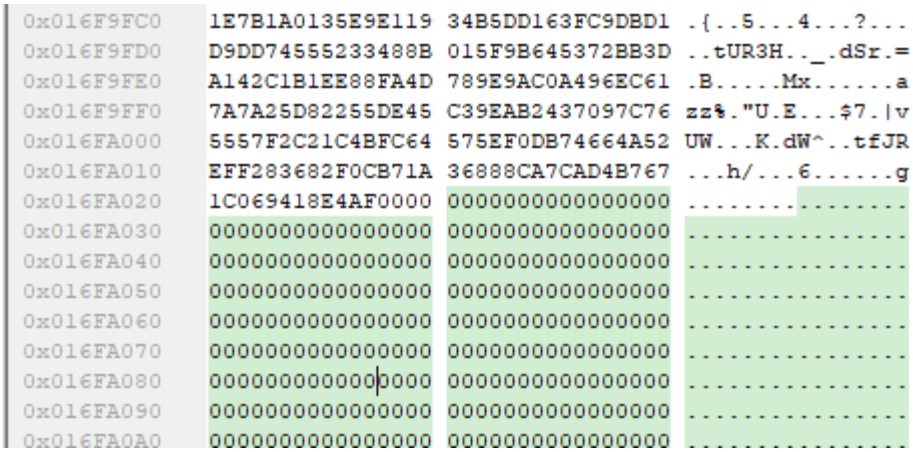
The Hex/String Viewer Settings window contains configuration options for the Hex/String Viewer.




## Hex Viewer Settings

**Arrange By**
Change the hex groupings in the hex view

**Show File Slack Space**
If checked, the end of file slack space (up to the end of cluster) will be shown in the hex view.




## String Extraction Settings

**Min. String Length**
The minimum length of the string to be included in the extracted string list

**Max. String Length**
The maximum length of the string to be included in the extracted string list

**Repeating Character Limit**
The maximum number of repeating characters a string may contain to be included in the extracted string list

**Case Change Limit**
The maximum number of case changes for a string to be included in the extracted string list

**Include Special Characters**
If checked, strings containing the following special characters are included in the extracted string list:

```
~!@#$%^&*()-_=+[{]}\|;:,'.>/?
```

### 5.18.3 Text Viewer

The text viewer displays the data stream as text.

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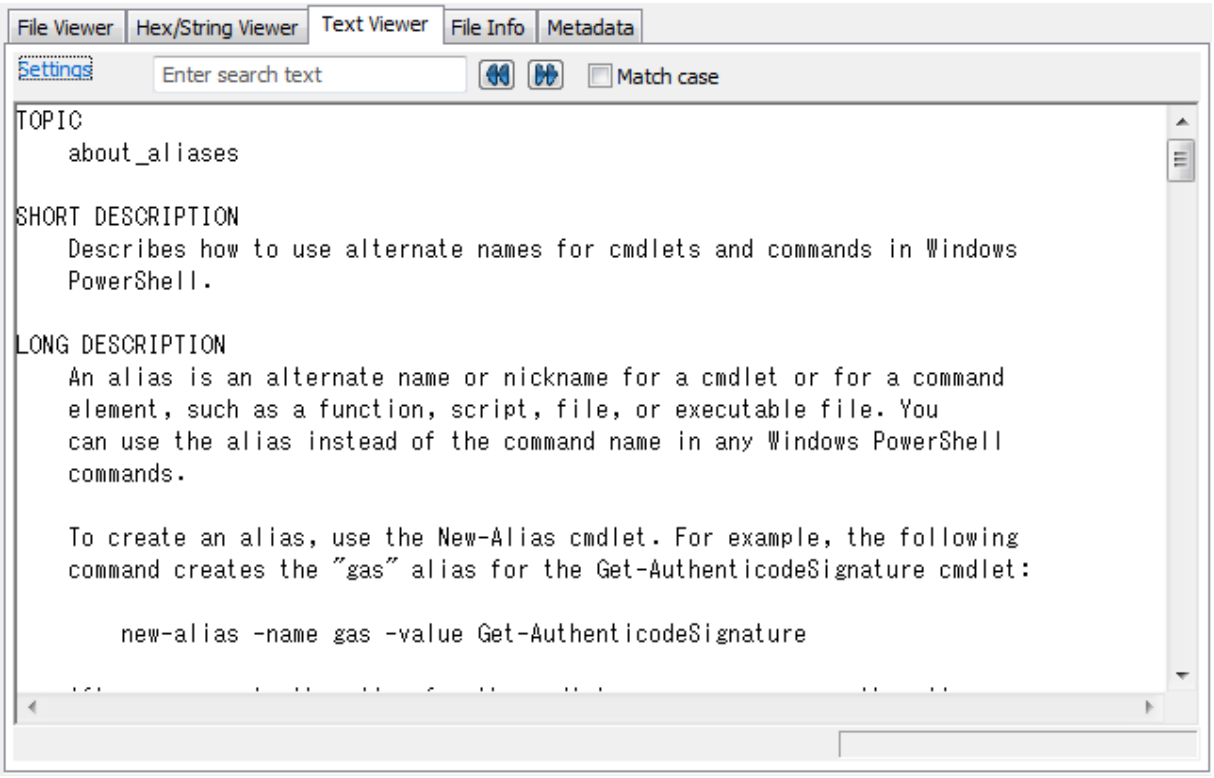
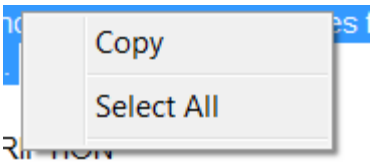



**Text View**
The htext view displays the data stream as text. Right-clicking opens a context menu that allows the user to copy the text into the clipboard.

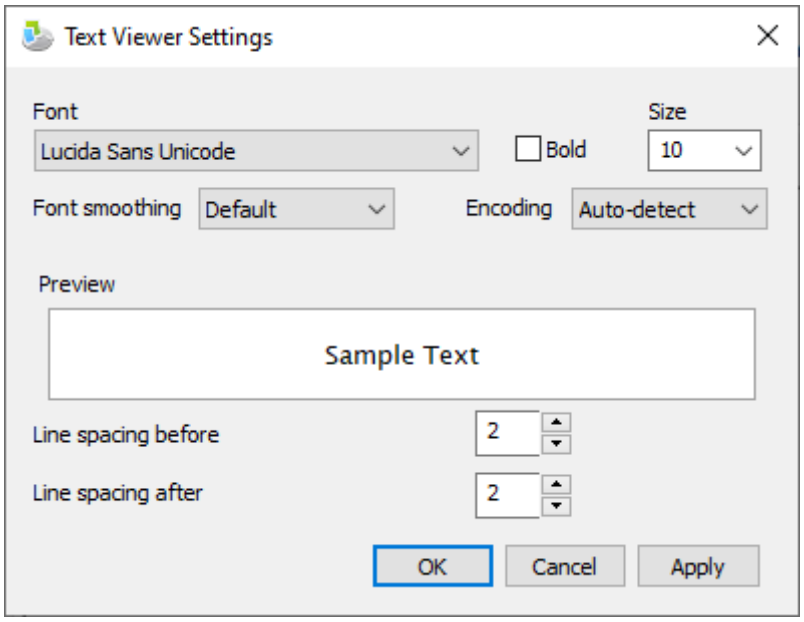



The font settings can be configured via the Settings window.

**Text View Search**
The user may enter a string pattern to search for in the text view. Use the left/right buttons to search for the previous/next match.

### 5.18.3.1 Text Viewer Settings

The Text Viewer Settings window contains configuration options for the Text Viewer.




**Font**
The font to use when displaying the text in the text view

**Bold**
If checked, all text will be bolded

**Size**
The font size of the text

**Font smoothing**
The quality of the font to display the text in

**Encoding**
The character encoding to view the text in. Choose Auto-detect to automatically determine the character encoding or a specific encoding to force the viewer to use.

**Line spacing before**
The spacing before each line

**Line spacing after**
The spacing after each line

### 5.18.4 File Info

The file info view displays attributes of the data stream.

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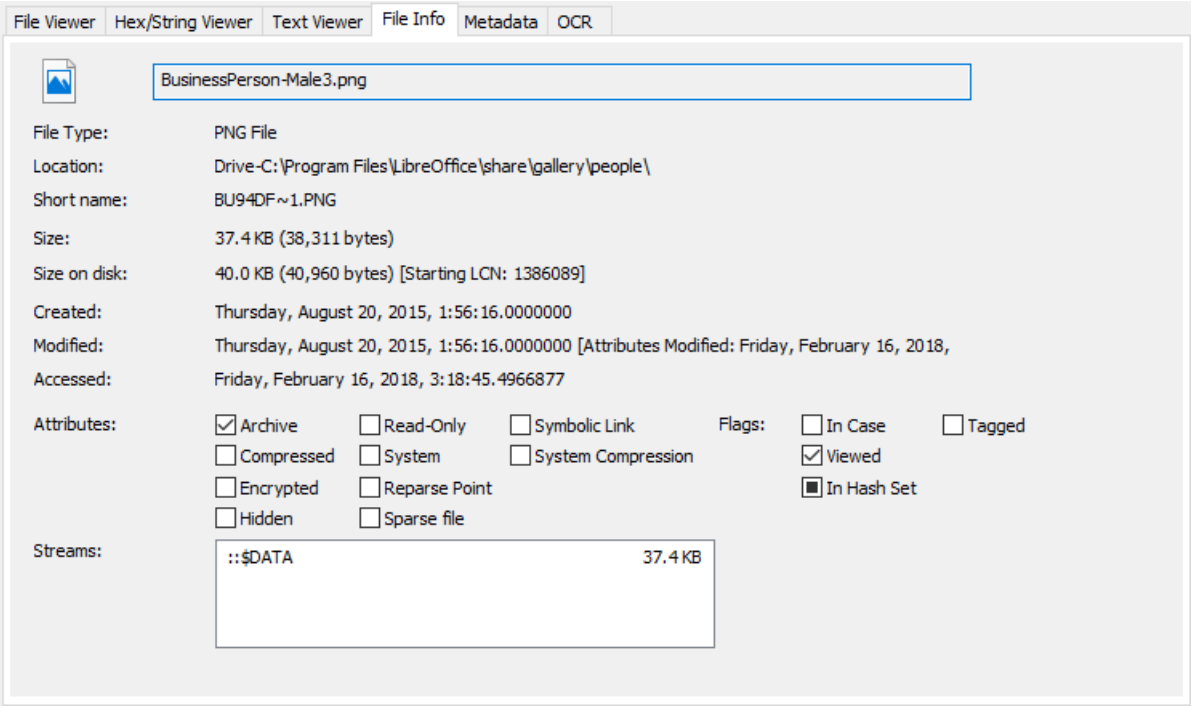


**File Type**
The type corresponding to the data stream. For files, this corresponding to the file extension.

**Location**
The location of the data stream on disk

**Short name**
If available, the 8.3 filename convention used by older versions of DOS and Windows.

**Size**
The size of the data stream

**Size on disk**
The size of the data stream that is actually allocated on disk

**Created**
The date that the file was created.

**Modified**
The date that the file was modified. If applicable, the date that the file's attribute was modified shall also be displayed (eg. MFT Modified Date).

**Accessed**
The date that the file was accessed.

**Attributes**
The attribute flags that are set for the data stream.

***Archive*** *- This flag indicates whether or not the file has been backed up. When set, the file is flagged to be backed up.*

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***Compressed*** *- The file is compressed.*
***Encrypted*** *- The file is encrypted.*
***Hidden*** *- The file is hidden.*
***Read-Only*** *- The file is read-only*
***System*** *- The file is a system file.*
***Reparse Point*** *- (NTFS only) The file contains a reparse point, which is a collection of user-defined data. Typically, reparse points are used to indicate NTFS hard links or system compression.*
***Sparse File*** *- The file contains sparse data, which is a segment of data which contains all zeroes. This segment of data is not allocated on disk and therefore reduces the disk space used by the file.*
***Symbolic Link*** *- (POSIX only) The file is a symbolic link to another file.*
***System Compression*** *- (NTFS only) The file is compressed using the Windows 10 'CompactOS' or 'System Compression' feature.*

**Streams**
(NTFS only) The list of streams contained in the file, including the default stream.

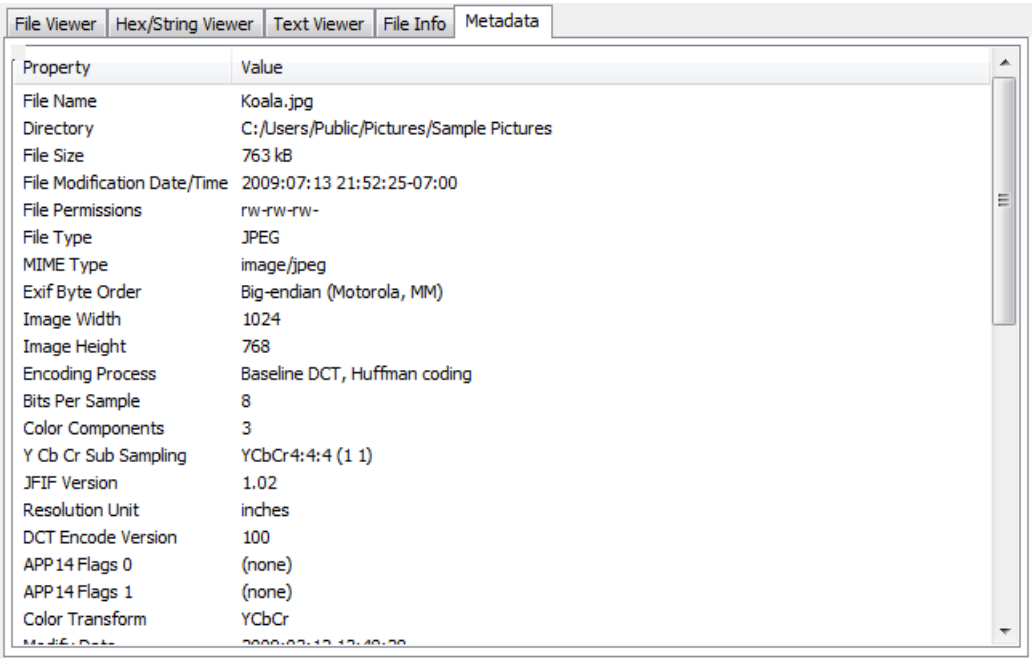
*Note: When opening files that belong to a case, the location and file times of the original file shall be displayed.*

### 5.18.5 Metadata

The metadata view displays file format specific metadata of the current item.

## Files

For files, file format specific metadata obtained using the ExifTool 3rd party tool is displayed. This is only available for files and not memory sections or raw sectors.




The metadata can be copied to clipboard, or exported to a text file from the right-click menu.

EXIF metadata information can be included in the case report. To do this, select "Include EXIF Metadata" option when adding items to case.

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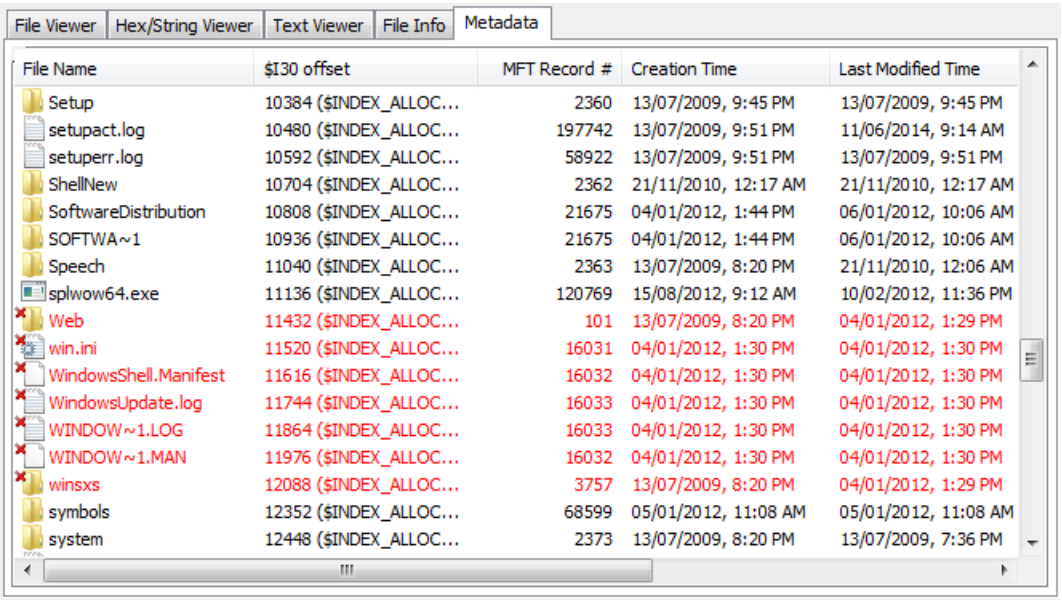
To fine adjust what EXIF tags to include in the case report, go to Manage Case and open the Case Item Properties, then check/uncheck the tags to enable/disable the tags.

## NTFS Directories

In particular for NTFS directories, the metadata view displays the $I30 entries of the folder, which includes entries that have been deleted. This is useful for identifying files or folders that used to belong to the directory (which may or may not be found in a deleted files search)




The $I30 entries can be copied to clipboard, or exported to a text file from the right-click menu.

## LNK Files

The metadata view displays the embedded information that can be found within a shortcut (.lnk) file. Which includes information when the shortcut was created and current and birth MAC address of the machine the shortcut resides on.

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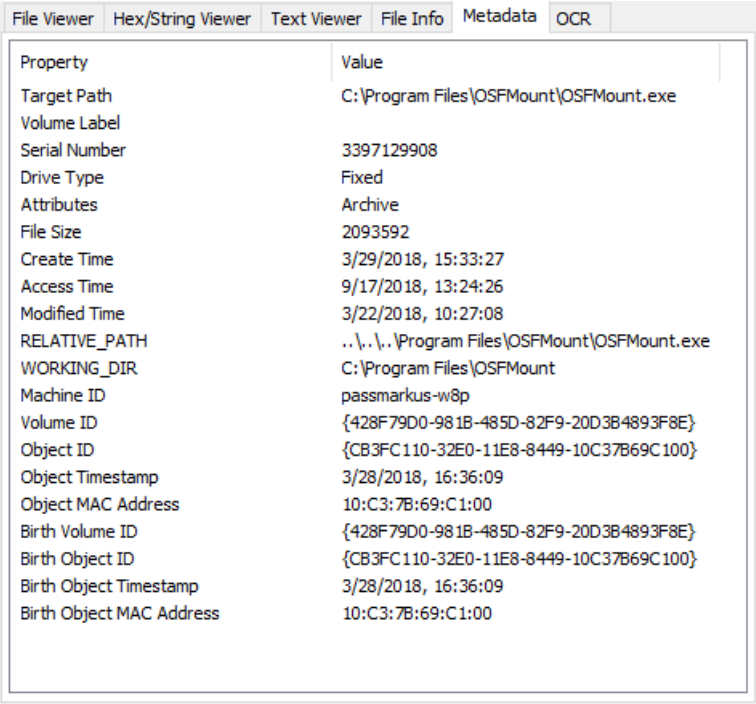


The entries can be copied to clipboard, or exported to a text file from the right-click menu.

### 5.18.6 File Entropy

The Entropy Viewer displays the entropy of the current item.

**File Type**
The type corresponding to the data stream. For files, this corresponding to the file extension.

**Location**
The location of the file or data stream on the device.

**Size**
The size of the file or data stream.

**Entropy**
File entropy measures the randomness of the data in a file. A low entropy value indicates that the file is not encrypted or compressed, while high entropy value means the data is random enough that it may be either compressed or encrypted. The entropy value will be in a range [0,8], with 0 being no entropy at all, and 8 being the maximum entropy. The more a unit can be compressed, the lower the entropy value; the less a unit can be compressed, the higher the entropy value. See https://en.wikipedia.org/wiki/Entropy_(information_theory)

**Chi Square Distribution**

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The Chi Square ($\chi^2$) distribution is used to determine the deviation of observed results from expected results. The Chi Square test looks at the pattern of bytes in the file and will tell us if certain combinations occur more frequently than we would expect by chance. The Chi Square distribution is calculated for the stream of bytes and expressed as an absolute number. Chi Square will be larger to the extent that the observed results diverge from those expected by chance. You test whether a obtained value is statistically significant by testing it against a table of Chi Square distributions for a given number of degrees of freedom (minus 1). There are 256 possible byte values, the table below shows the probability chance for 255 (256 degrees of freedom -1). Shown in OSForensics is the probability that a file would randomly exceed the stated value the percentage of the time. See https://en.wikipedia.org/wiki/Pearson%27s_chi-squared_test

| | Significance Level | | | | | |
|---|---|---|---|---|---|---|
| **Chance Probability** | 0.100 | 0.050 | 0.025 | 0.010 | 0.005 | 0.001 |
| **Critical Value** | 284.3359 | 293.2478 | 301.1250 | 310.4574 | 316.9194 | 330.5197 |

**Monte Carlo Pi**
The Monte Carlo simulation is used to approximate the value of Pi ($\pi$) from a given set of random (x,y) coordinates. The bytes of the file are converted to (x,y) coordinate, the more random the data in the file, the closer the approximation should be to the actual value of Pi. Very accurate Pi approximations indicate a very random set of data points. The Error % (percentage) displays the percentage the estimation is from Pi. The Pi value used in the error calculation is 3.14159265358979323846. See https://blogs.sas.com/content/iml/2016/03/14/monte-carlo-estimates-of-pi.html and https://en.m.wikipedia.org/wiki/Monte_Carlo_method

**Quick Analysis**
Using the Entropy, Chi Square and Monte Carlo Pi and built in encryption detection for certain file types. OSForensics will try to determine if the file is a "Normal", "Compressed", or possibly an "Encrypted" file. Important: The analysis provides a rough guide as to what files may need to be reviewed based on entropy values calculated. There is a chance the detection may provide false positives, especially for file types that are random by design, i.e. compressed, e.g. image or encoded multimedia files. The guideline values used for analysis of a file for encryption and/or compression is based on a blog post on /dev/ttyS0 site titled "Differentiate Encryption From Compression Using Math", (http://www.devttys0.com/2013/06/differentiate-encryption-from-compression-using-math/, Note: Link is no longer available). The summarized findings are:

- Large deviations in the chi square distribution, or large percentages of error in the Monte Carlo approximation are sure signs of compression.
- Very accurate pi calculations (< .01% error) are sure signs of encryption.
- Lower chi values (< 300) with higher pi error (> .03%) are indicative of compression.
- Higher chi values (> 300) with lower pi errors (< .03%) are indicative of encryption.

**Byte Distribution**
This chart shows the number of time each byte appears in a file. Each byte in a file can have one of 256 possible values: 0 (0x00) to 255 (0xFF). In a file with random data (e.g. compressed or encrypted), the chart will have a very even distribution of byte values between 0 and 255 inclusive. In a text file, we would expect bytes in the printable ASCII range to occur more often.

**File Entropy**
The chart displays the entropy of a file in increments of block size. Each point in the chart represents one block (minimum block size is 512 bytes). For large files, the block size is adjusted so that a maximum of 32768 points (or blocks) that can be plotted on the chart. This chart can be useful to find embedded section of low entropy blocks (e.g. may contain readable text) in otherwise an overall high entropy file, e.g. areas of text hidden in image files. The images would look like any other image when viewed but this chart can help locate areas of possible interest within the file.

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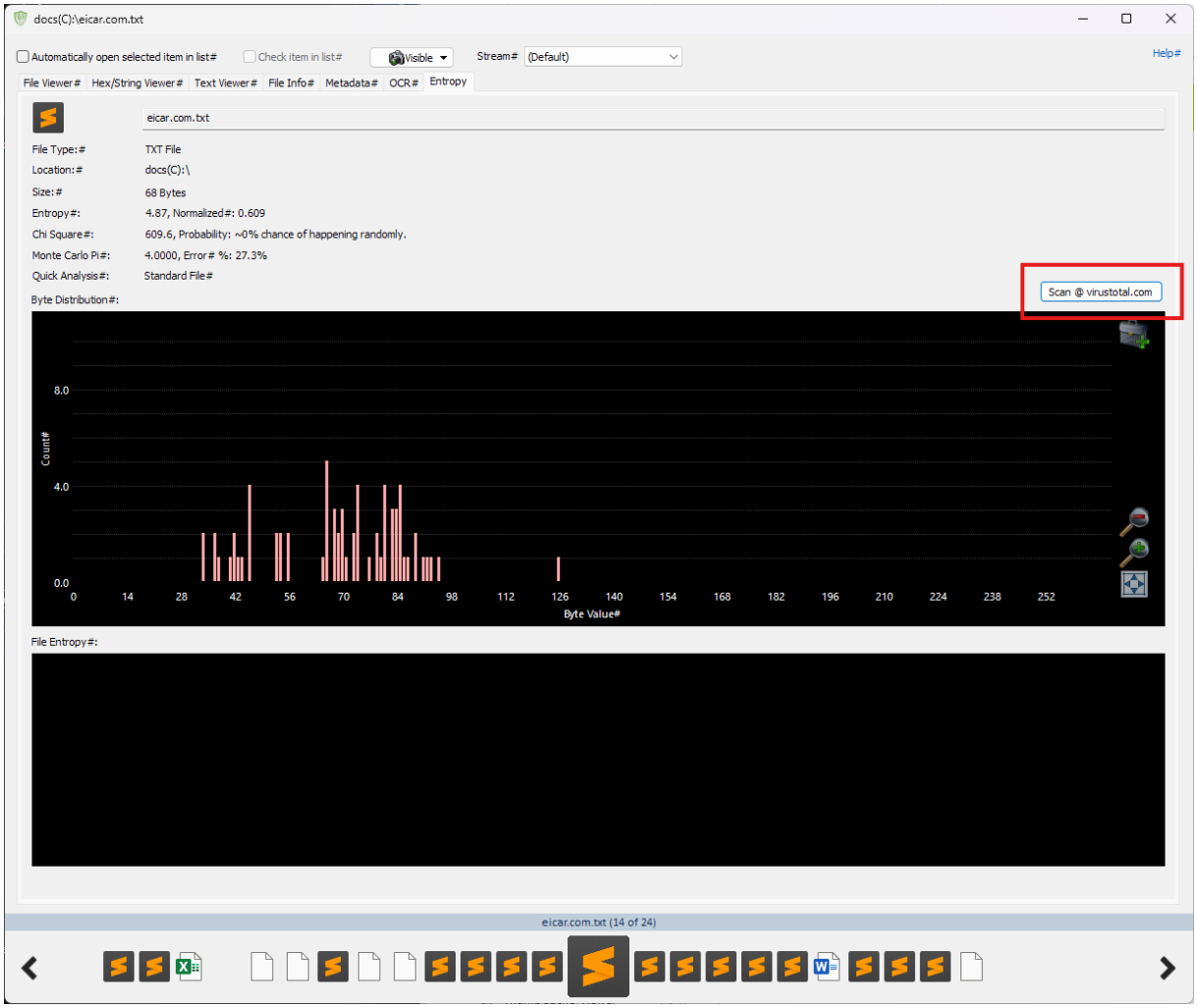
## 5.18.7 VirusTotal Scan

The contents of files can be scanned for malware directly from the internal viewer interface.

OSForensics utilizes the cloud based aggregate virus scanner VirusTotal to determine the likelihood that a particular file contains malicious code.

This feature can be accessed from the entropy viewer tab of the internal file viewer.




**API Key**
In order to use the VirusTotal cloud API, the user must supply their own API key.

A key can be obtained from the VirusTotal website and requires the user to create an account.

This can be done at: https://virustotal.com

Note that VirusTotal is a third party provider and usage of this service is subject to the VirusTotal terms and conditions.

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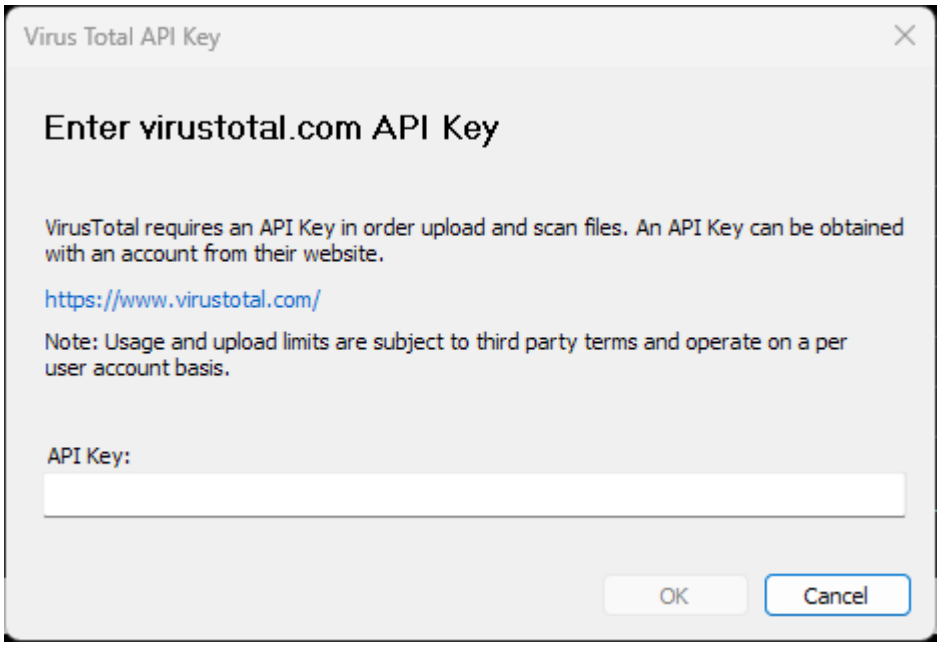
Upon attempting to scan a file for the first time, OSForensics will provide a prompt to enter your API Key.

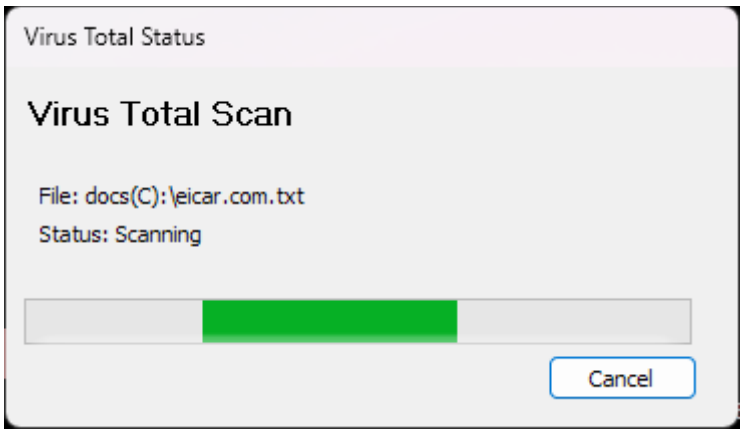



Once entered, This key will be saved to "C:/"current_user"/Documents/Passmark/OSForensics/VirusTotalAPIKey.txt"

If you need to re-enter your API key, this file can be modified to replace the original key entered.

**Scanning**
Once the API key has been accepted, OSForensics will upload the selected file to the cloud scanning service. The scan for malicious software will then begin on the VirusTotal server.

OSForensics will report the current status of the scan as it progresses.




**Scan Results**

VirusTotal is an aggregate virus scanner which means that the file is simultaneously scanned by over 70 individual virus scanner engines.

The results of this scan will be saved to the users documents folder in the location: "C:/"current_user"/Documents/Passmark/OSForensics/ScanResults".

The scan result file will contain both a summary, the number of engines and the category each engine put the file in and the list of the individual results from each engine in turn.

The categories a file can be placed into include:

**Malicious -** The file is known to contain malicious code
**Suspicious -** The file may contain malicious code
**Undetected -** The file has not been marked as malicious by this engine
**Harmless -** The file is known to be non malware by the engine
**Failure -** The engine could not process this file
**Type Unsupported -** The engine cannot provide a scan for this file type

## 5.19 JSON Viewer

The JSON Viewer parses and displays JSON file contents.

JSON Viewer basic features:
- Syntax highlighting for JSON documents
- Treeview shows the hierarchical dependencies between JSON nodes
- JSON formatting and indenting
- Compressing (minifying) JSON documents
- Supported encoding: UTF8, ASCII, UTF16 BE/LE

The font settings can be configured via the Settings window.

## JSON Parser

### Google Hangouts

A parser for Google Hangouts conversation history.
Download Hangouts chat history from Google Takeout and load the "Hangouts.json" file for decoding.

- View conversations in HTML with nicely formatted chatting app style
- Export to HTML/CSV/TXT file formats

### Google Location History

A parser for Google Location History data.
Download Location History in Json format from Google Takeout and load the "Location History.json" file for decoding.

- Locations can be viewed on internal Map Viewer
- Export to KML/GPX/CSV file formats
- Analyze exports using Google Earth, Google Maps My Maps or Power BI ... (see the examples below)

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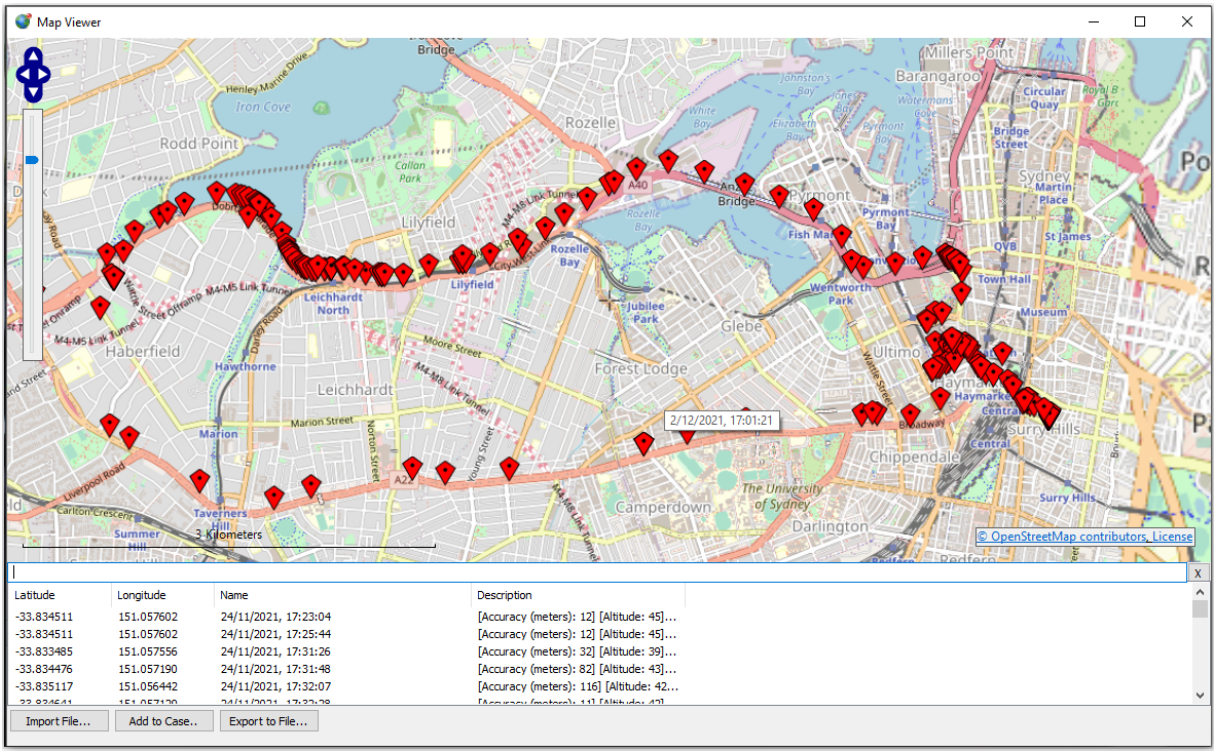
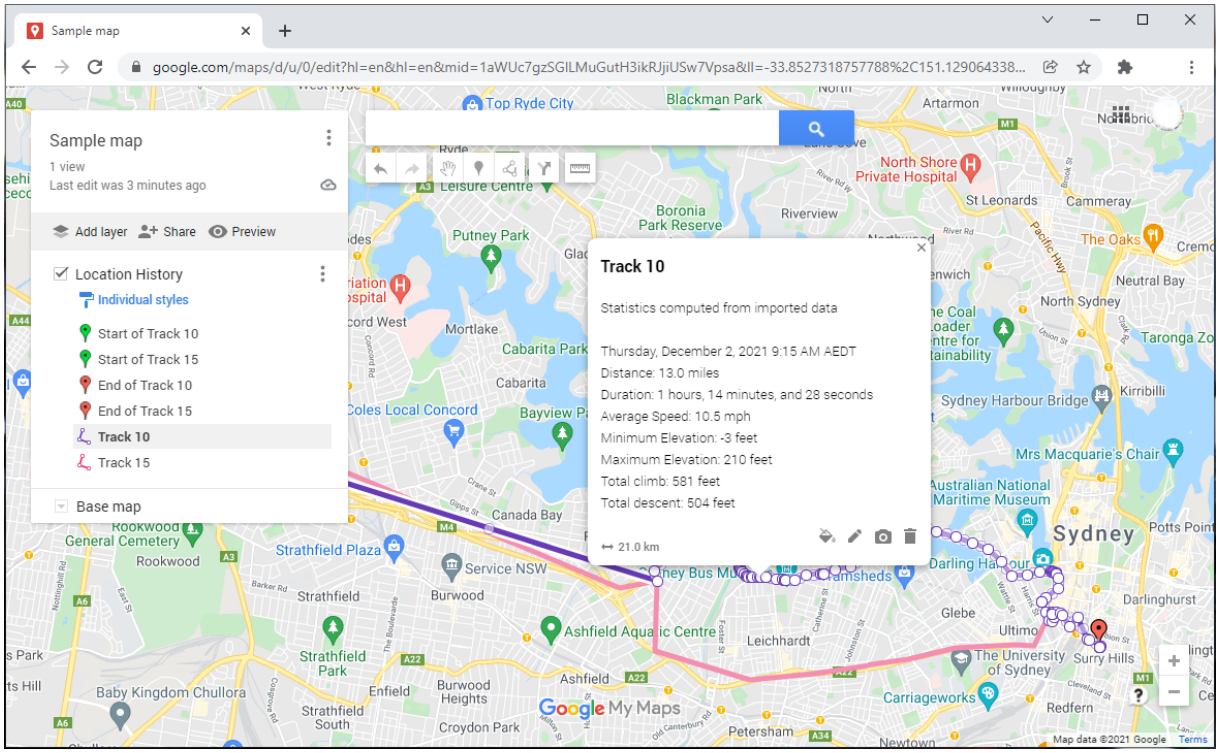
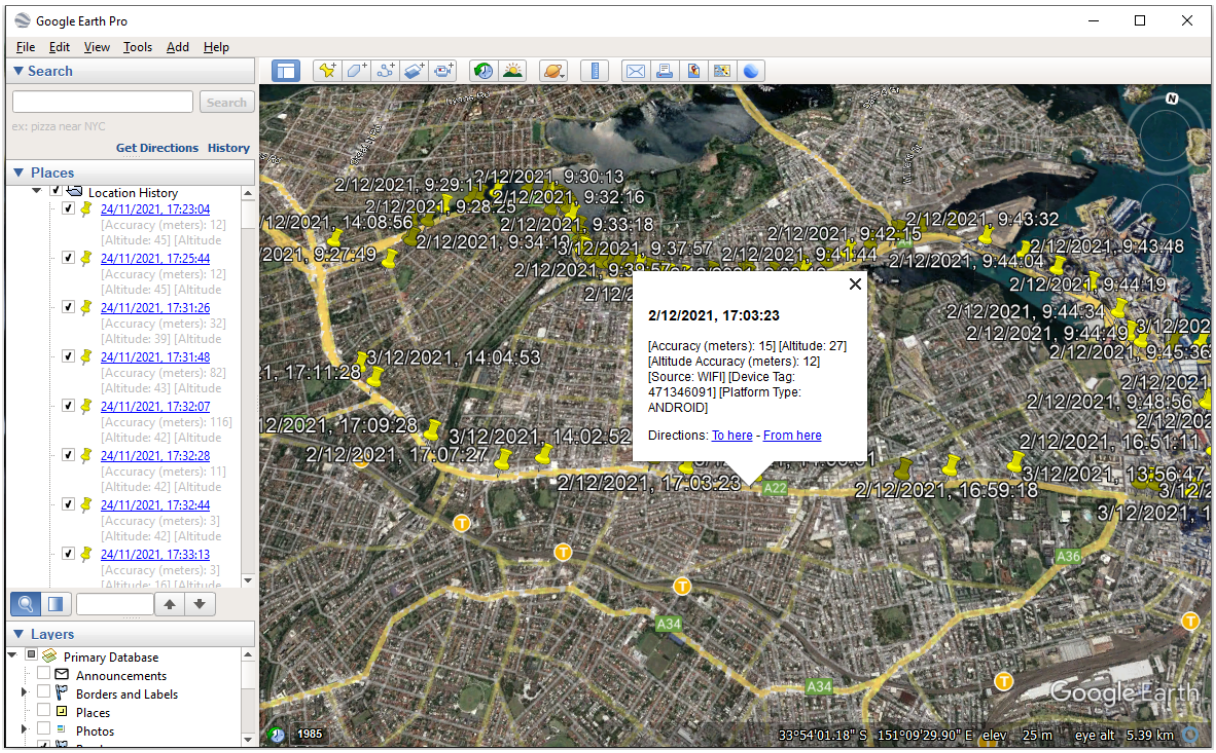
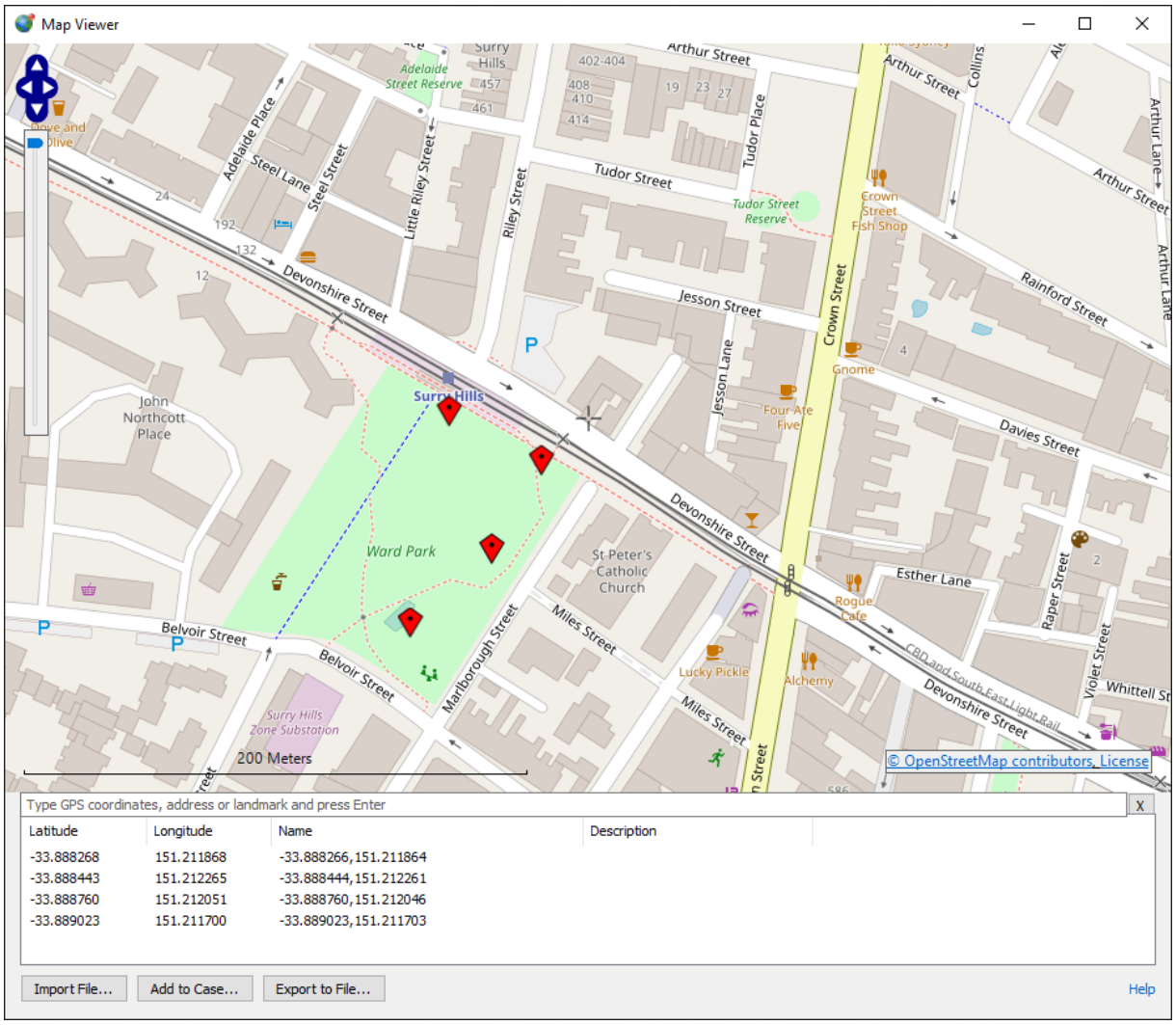

Map Viewer
2/12/2021, 17:01:21
© OpenStreetMap contributors, License
Latitude Longitude Name Description
-33.834511 151.057602 24/11/2021, 17:23:04 [Accuracy (meters): 12] [Altitude: 45]...
-33.834511 151.057602 24/11/2021, 17:25:44 [Accuracy (meters): 12] [Altitude: 45]...
-33.833485 151.057556 24/11/2021, 17:31:26 [Accuracy (meters): 32] [Altitude: 39]...
-33.834476 151.057190 24/11/2021, 17:31:48 [Accuracy (meters): 82] [Altitude: 43]...
-33.835117 151.056442 24/11/2021, 17:32:07 [Accuracy (meters): 116] [Altitude: 42...
Import File...
Add to Case..
Export to File...


Sample map
google.com/maps/d/u/0/edit?hl=en&hl=en&mid=1aWUc7gzSGILMuGutH3ikRJjiUSw7Vpsa&ll=-33.8527318757788%2C151.129064338...
Sample map
1 view
Last edit was 3 minutes ago
Add layer
Share
Preview
Location History
Individual styles
Start of Track 10
Start of Track 15
End of Track 10
End of Track 15
Track 10
Track 15
Base map
Track 10
Statistics computed from imported data
Thursday, December 2, 2021 9:15 AM AEDT
Distance: 13.0 miles
Duration: 1 hours, 14 minutes, and 28 seconds
Average Speed: 10.5 mph
Minimum Elevation: -3 feet
Maximum Elevation: 210 feet
Total climb: 581 feet
Total descent: 504 feet
21.0 km
Google My Maps
Map data ©2021 Google
Terms




## 5.20 Map Viewer

The Map Viewer provides an interface for searching, importing and plotting location-based evidence on a world map. This includes GPS coordinates IP addresses, physical addresses and landmarks found in digital evidence.



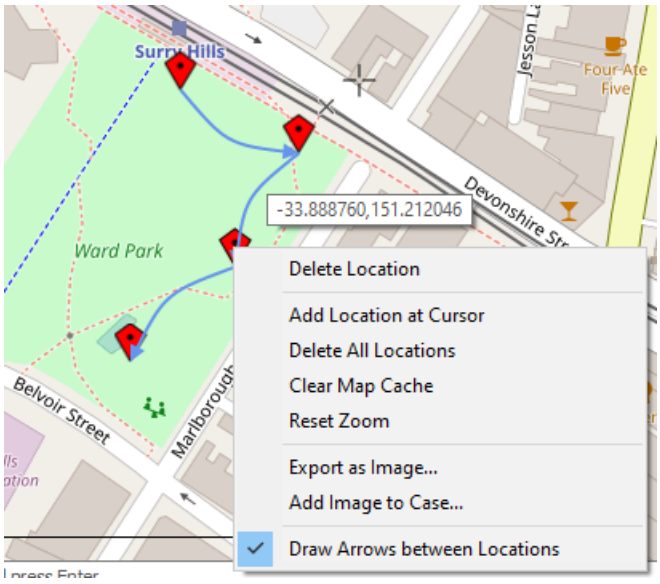

**Search**
Search for GPS coordinates IP addresses, physical addresses and landmarks on the world map.

**Import File...**
Import GPX, KML or CSV files containing GPS coordinates or IP addresses as pins on the map.

**Add to Case...**
Add the list of locations indicated by the pins on the map to the Case.

**Export to File...**
Save the list of locations indicated by the pins on the map to a CSV file.

## Right-click Menu




**Delete location**
Delete the selected location indicated by the pin.

**Add location at cursor**
Add and insert a pin at the location indicated by the cursor to the list.

**Delete all locations**
Delete and remove all pins from the map.

**Clear map cache**
Delete the downloaded map tiles cached on disk. This may fix issues related to map tiles not being drawn properly.

**Reset zoom**
Reset the zoom and pan to ensure all pins are visible.

**Export as image...**
Save the current map image as a PNG file on disk.

**Add image to Case...**
Add the current map image to the Case.

**Draw arrows between locations**
Draw arrows between each pin according to the list order.

## 5.21 Memory Viewer

The Memory Viewer module allows the user to perform memory forensics analysis on a live system or a static memory dump. There are 2 types of memory analysis that can be performed:

- Live Analysis
- Static Analysis

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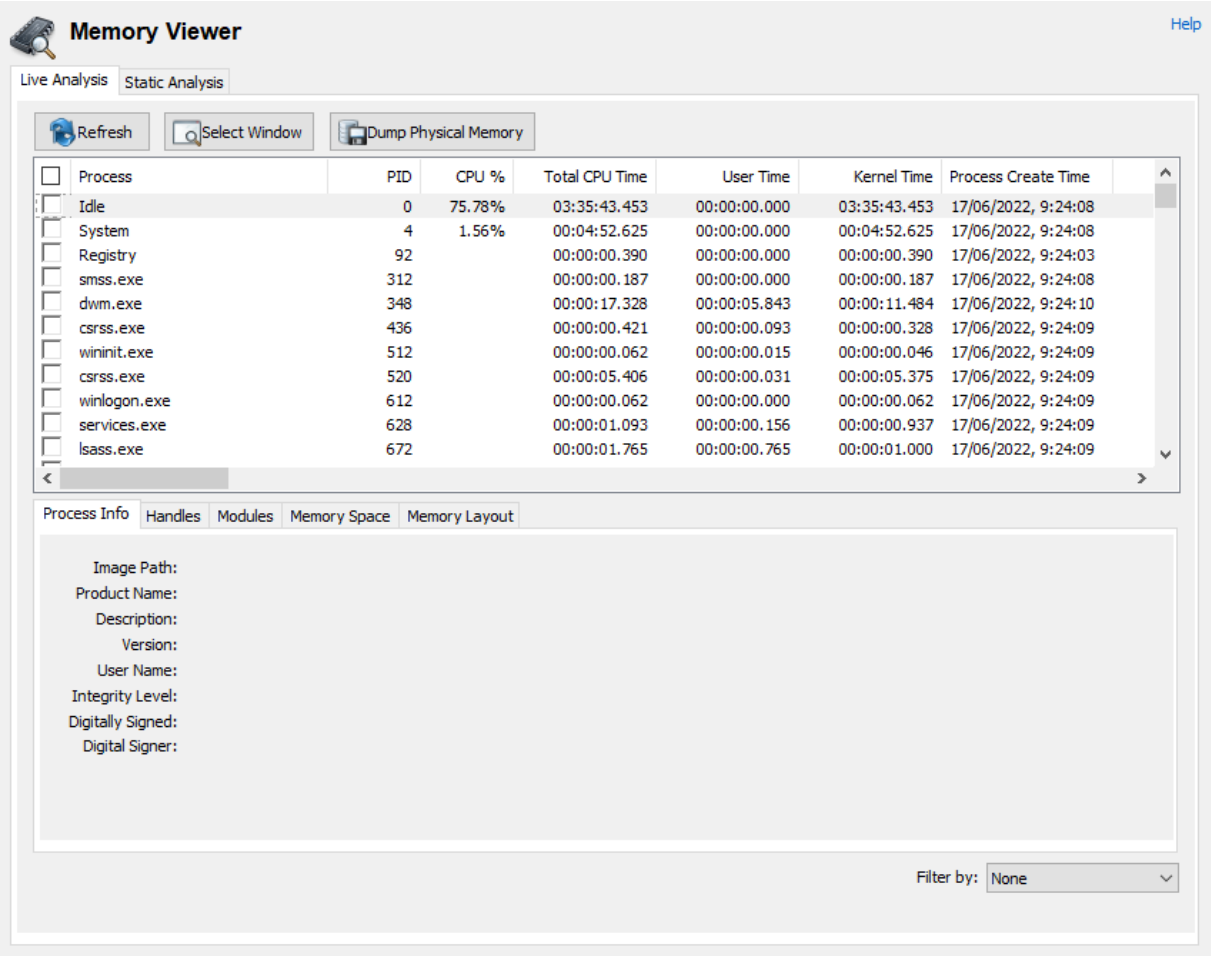


When performing 'Live Analysis', the memory details of all processes currently running on the system is displayed in a Task Manager-like view. Unlike non-volatile hard disks which can be analyzed statically, memory contents (RAM) can only be analyzed while the system is live. Furthermore, it is possible that potentially implicating evidence exists only in the system's physical memory, without any traces on the hard disk. This matter is complicated further if the data only exists in memory for a brief period of time.

'Static Analysis' allows an investigator to perform an analysis of a memory snapshot dump that had been taken recently. The results of a static analysis can include the following:

- List of processes that were running
- List of suspicious processes
- Installed drivers
- Detected Malware

### 5.21.1 Live Analysis

The Live Analysis tab of the Memory Viewer displays the real-time information of the processes that are running on the system.

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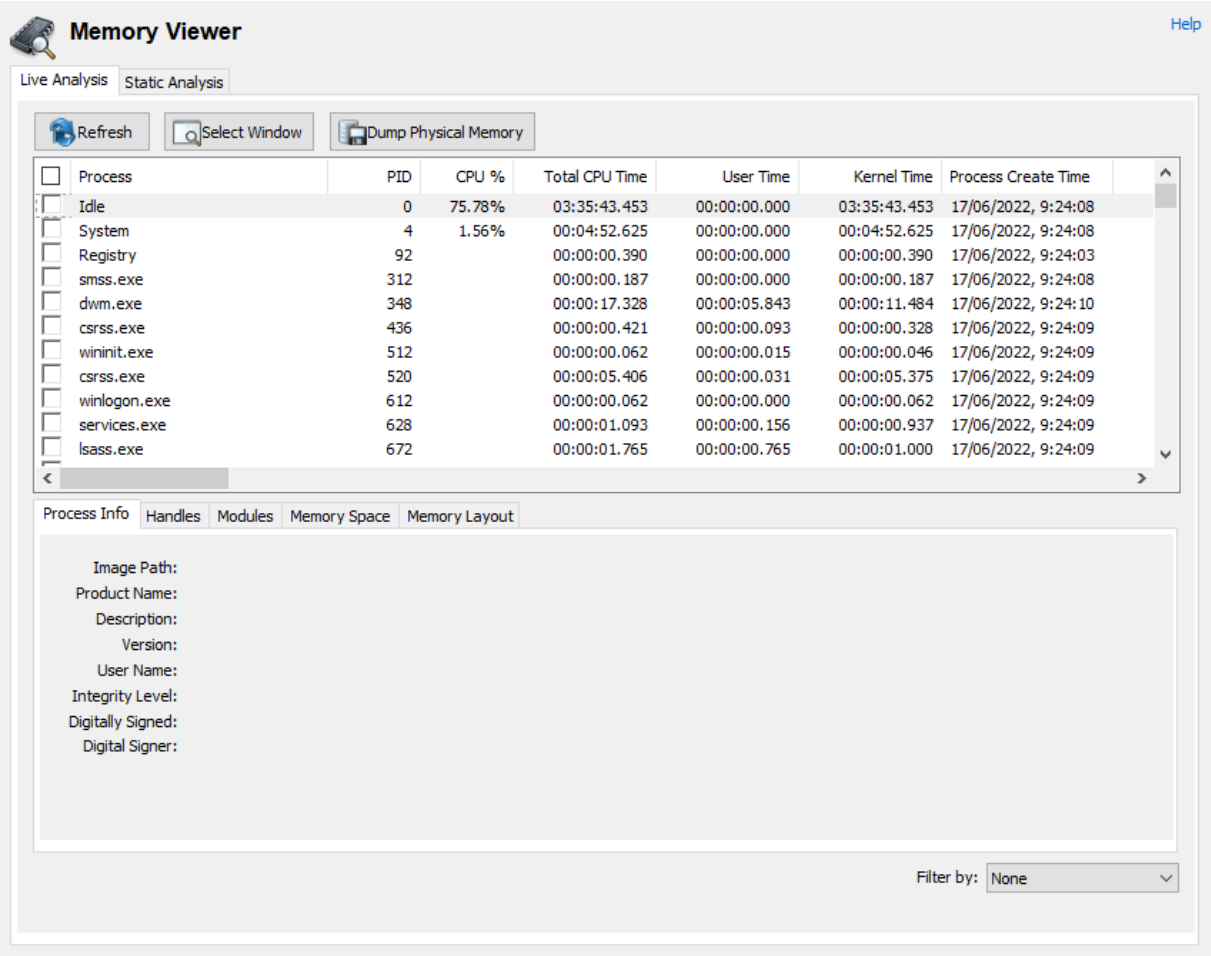


By selecting a process, the user may view the process information, virtual memory space and memory layout.

**Refresh**
Refreshes the list of active processes in the system.

**Select Window**
Allows the user to select a process by clicking on its window.

**Dump Physical Memory**
Dump the entire physical memory into a binary file. See Generating a Raw Memory Dump.

Right-clicking the process list view allows the user to save the list of processes to a CSV file.

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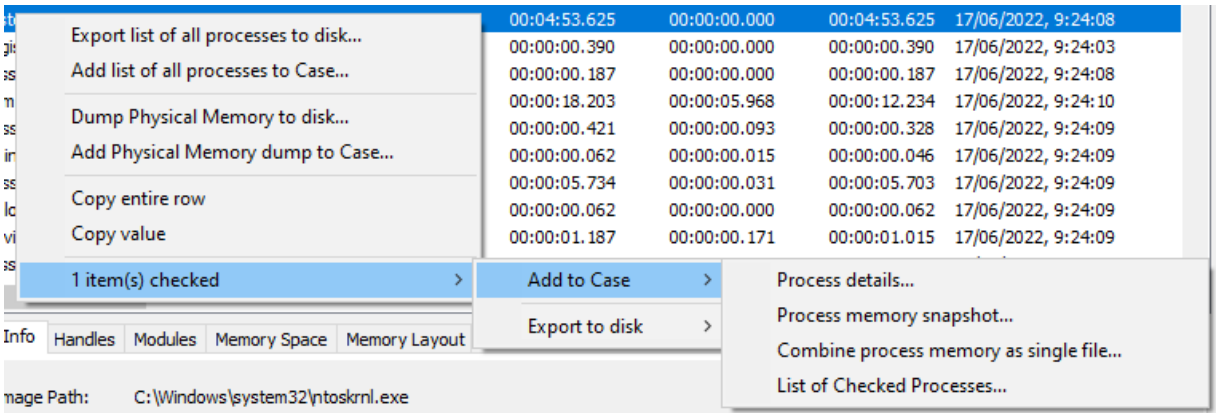


**Export list of all processes to disk...**
Take a snapshot of the list of all running processes and save as CSV on disk

**Add list of all processes to Case...**
Take a snapshot of the list of all running processes and add to the case.

**Dump Physical Memory to disk...**
Dump the entire physical memory into a binary file on disk. See Generating a Raw Memory Dump.

**Add Physical Memory dump to Case...**
Dump the entire physical memory and add to the case. See Generating a Raw Memory Dump.

**Copy entire row**
Copy the text of the selected row to clipboard

**Copy value**
Copy the text of the selected cell to clipboard

**X items(s) checked**
**Add to Case/Export to disk**
**Process Details...**
Take a snapshot of the selected process details and save to case/disk

**Process Memory Snapshot...**
Take a memory dump snapshot of the selected process details and save to case/disk

**Combine Process Memory as single file...**

**List of Checked Processes...**

**Add process to Case**
Take a snapshot of process details or memory dump of the selected process and add to the case.

## Process Info

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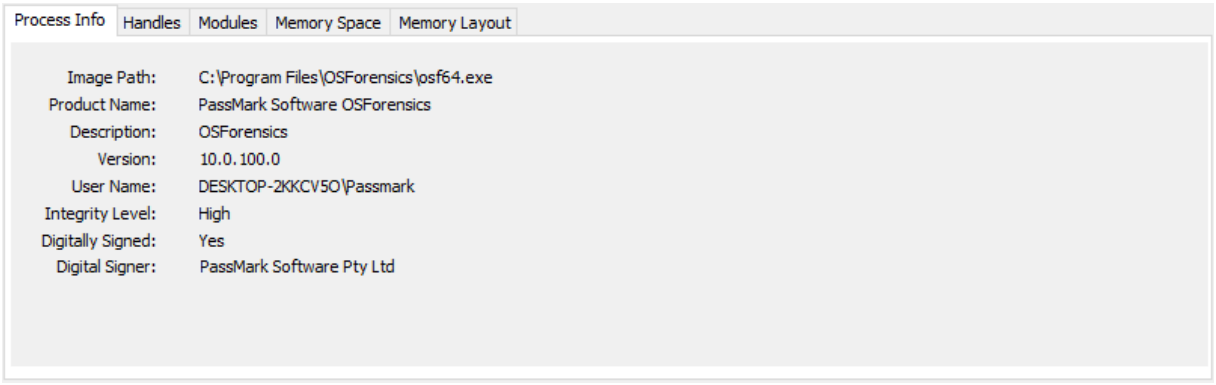
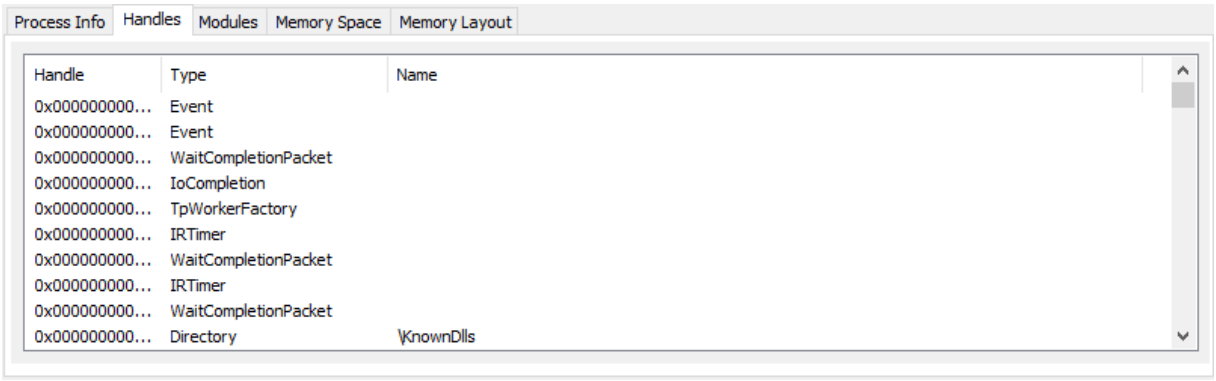


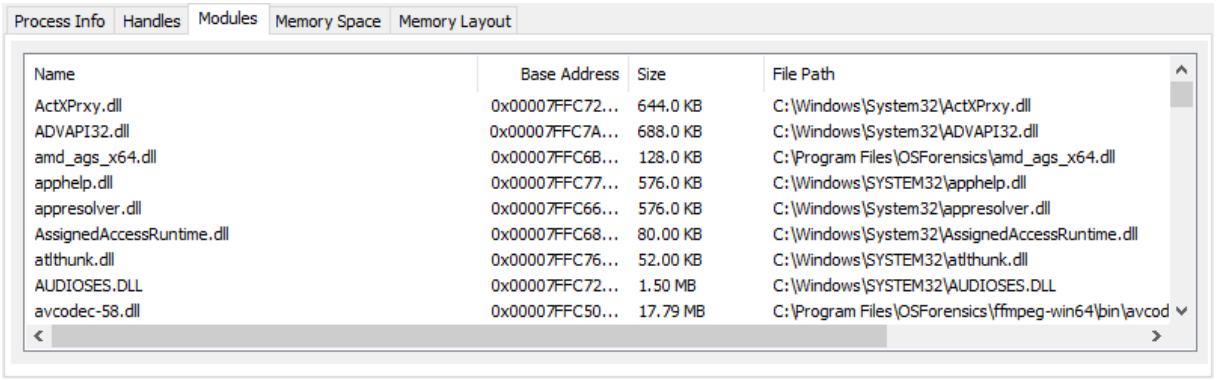

This view shows the details of the application whose process was created.

## Handles



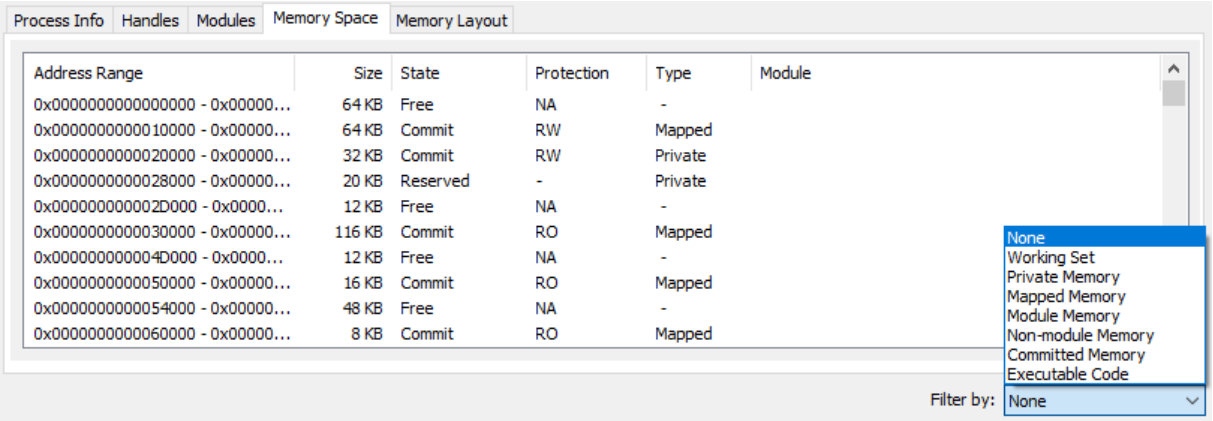

This view shows the list of handles used by the process, including the handle type and name (if available).

## Modules




This view shows the list of modules loaded by the process, including the location in process memory and the file path of the module.

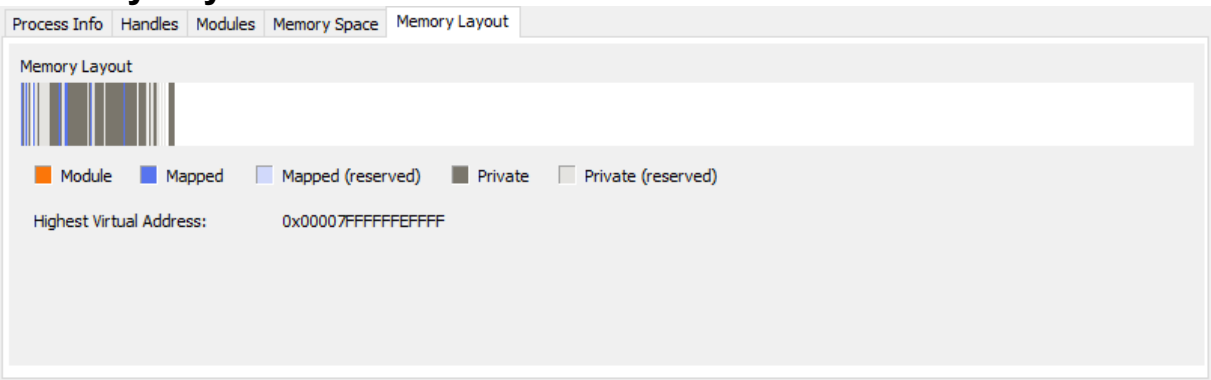
## Memory Space




This view shows the process' memory allocation within its virtual address space. Double clicking on a memory section opens the Internal Viewer. Right-clicking a memory section allows the user to dump the memory contents into a file (See Generating a Raw Memory Dump). The memory sections can also be filtered based on the following criteria:

- *None* - The entire process (user) memory space is displayed
- *Working Set* - Only the memory sections that are in physical RAM are displayed
- *Private* - Only the memory sections that are private are displayed
- *Mapped* - Only the memory sections that are mapped are displayed
- *Module* - Only the memory sections that are part of an image are displayed
- *Non-module* - All memory sections that are not part of an image are displayed
- *Committed* - Only the memory sections that are in a commit state are displayed
- *Executable code* - Only the memory sections that have execute permissions are displayed

## Memory Layout




This view shows a graphical layout of the allocated memory sections within the process virtual address space.

### 5.21.1.1 Generating a Raw Memory Dump

Using the OSForensics Memory Viewer, the user may perform a raw memory dump of a particular process' virtual memory space or the entire system's physical memory space.

Performing a process memory dump saves the contents of a process' virtual memory space (both in physical memory or paged out to hard disk) into a file. This is useful especially if there is a specific process that the user has identified to potentially contain information of interest.

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Generating a raw physical memory dump takes a snapshot of the system's physical RAM contents, allowing the user to perform a static analysis of the raw memory contents. Since the contents of physical RAM are valid only when the system is live, performing a physical memory dump saves the RAM contents in a persistent state allowing for a more thorough analysis at a later time. Information that can be extracted from a raw physical memory dump includes the following:

- Printable strings (such as passwords, addresses, phone numbers, e-mail addresses)
- Kernel data structures (such as process list, thread list, module list)

There are a variety of commercial and free 3rd party tools that scans raw physical memory dump files and extracts information that could be useful for forensic investigations. A physical memory dump, however, will unlikely contain the collective memory space of all processes running on the system. This is due to the fact that only a portion of a process' memory space resides in physical memory; the remaining portions reside in a page file on the hard disk.

## Password Retrieval Example

To demonstrate a simple case of retrieving a password string from memory, we use a popular FTP client as an example. We configure a connection to a dummy FTP server using these parameters:

```
Host:          ftp.testftpserver.com
Port           1331
User           testuser
Password testPassword
```

After inputting these parameters, we attempt to connect to the dummy FTP server. While the FTP client is trying to connect to the non-existent server, we generate a raw memory dump of the FTP process using OSForensics. Using the OSForensics internal viewer (or any hex viewer/editor), we perform a simple search for our password string 'testPassword'. The screenshot below reveals the result of the string search.

```
010A1EB0 20 20 20 20 20 20 20 20 3C 48 6F 73 74 3E 66 74         <Host>ft
010A1EC0 70 2E 74 65 73 74 66 74 70 73 65 72 76 65 72 2E p.testftpserver.
010A1ED0 63 6F 6D 3C 2F 48 6F 73 74 3E 0D 0A 20 20 20 20 com</Host>..
010A1EE0 20 20 20 20 20 20 20 20 3C 50 6F 72 74 3E 31 33         <Port>13
010A1EF0 33 31 3C 2F 50 6F 72 74 3E 0D 0A 20 20 20 20 20 31</Port>..
010A1F00 20 20 20 20 20 20 20 3C 50 72 6F 74 6F 63 6F 6C        <Protocol
010A1F10 3E 30 3C 2F 50 72 6F 74 6F 63 6F 6C 3E 0D 0A 20 >0</Protocol>..
010A1F20 20 20 20 20 20 20 20 20 20 20 20 3C 54 79 70 65             <Type
010A1F30 3E 30 3C 2F 54 79 70 65 3E 0D 0A 20 20 20 20 20 >0</Type>..
010A1F40 20 20 20 20 20 20 20 3C 55 73 65 72 3E 74 65 73        <User>tes
010A1F50 74 75 73 65 72 3C 2F 55 73 65 72 3E 0D 0A 20 20 tuser</User>..
010A1F60 20 20 20 20 20 20 20 20 20 20 3C 50 61 73 73 3E           <Pass>
010A1F70 74 65 73 74 50 61 73 73 77 6F 72 64 3C 2F 50 61 testPassword</Pa
010A1F80 73 73 3E 0D 0A 20 20 20 20 20 20 20 20 20 20 20 ss>..
010A1F90 20 3C 4C 6F 67 6F 6E 74 79 70 65 3E 31 3C 2F 4C  <Logontype>1</L
010A1FA0 6F 67 6F 6E 74 79 70 65 3E 0D 0A 20 20 20 20 20 ogontype>..
010A1FB0 20 20 20 20 20 20 20 3C 54 69 6D 65 7A 6F 6E 65        <Timezone
010A1FC0 4F 66 66 73 65 74 3E 30 3C 2F 54 69 6D 65 7A 6F Offset>0</Timezo
010A1FD0 6E 65 4F 66 66 73 65 74 3E 0D 0A 20 20 20 20 20 neOffset>..
010A1FE0 20 20 20 20 20 20 20 3C 50 61 73 76 4D 6F 64 65        <PasvMode
010A1FF0 3E 4D 4F 44 45 5F 44 45 46 41 55 4C 54 3C 2F 50 >MODE_DEFAULT</P
010A2000 61 73 76 4D 6F 64 65 3E 0D 0A 20 20 20 20 20 20 asvMode>..
```

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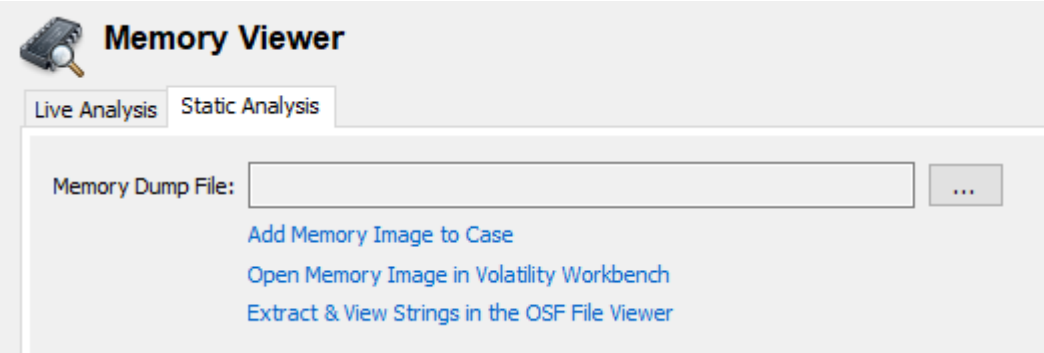
We can see that the password is stored as plain text in the process' memory. Using this information, a forensics investigator may gain access to a remote machine containing evidence files that could implicate the suspected criminal.

### 5.21.2 Static Analysis

A full physical memory dump contains valuable information about the state of the system when the snapshot was taken. The Static Analysis tab of the Memory Viewer allows an investigator to analyze a memory dump file in order to extract valuable information such as:

- List of processes that were running
- List of suspicious processes
- Installed drivers
- Detected Malware




To analyze a memory dump file, browse to the location of the file and click Analyze. This shall launch Volatility Workbench, a GUI application for the Volatility tool.

Volatility is a command line memory analysis and forensics tool for extracting artifacts from memory dumps.

To view the raw data and extract the strings from the memory dump file, click View & Extract Strings. This opens the internal viewer in hex view which provides tools to extract and discover strings of interest (eg. passwords) in the memory dump file.

## 5.22 Mismatch File Search

The Mismatch File Search Module can be used to locate files whose contents do not match its file extension. This module can uncover attempts to hide files under a false file name and extension by verifying whether the actual file format matches its intended file format based on the file extension.

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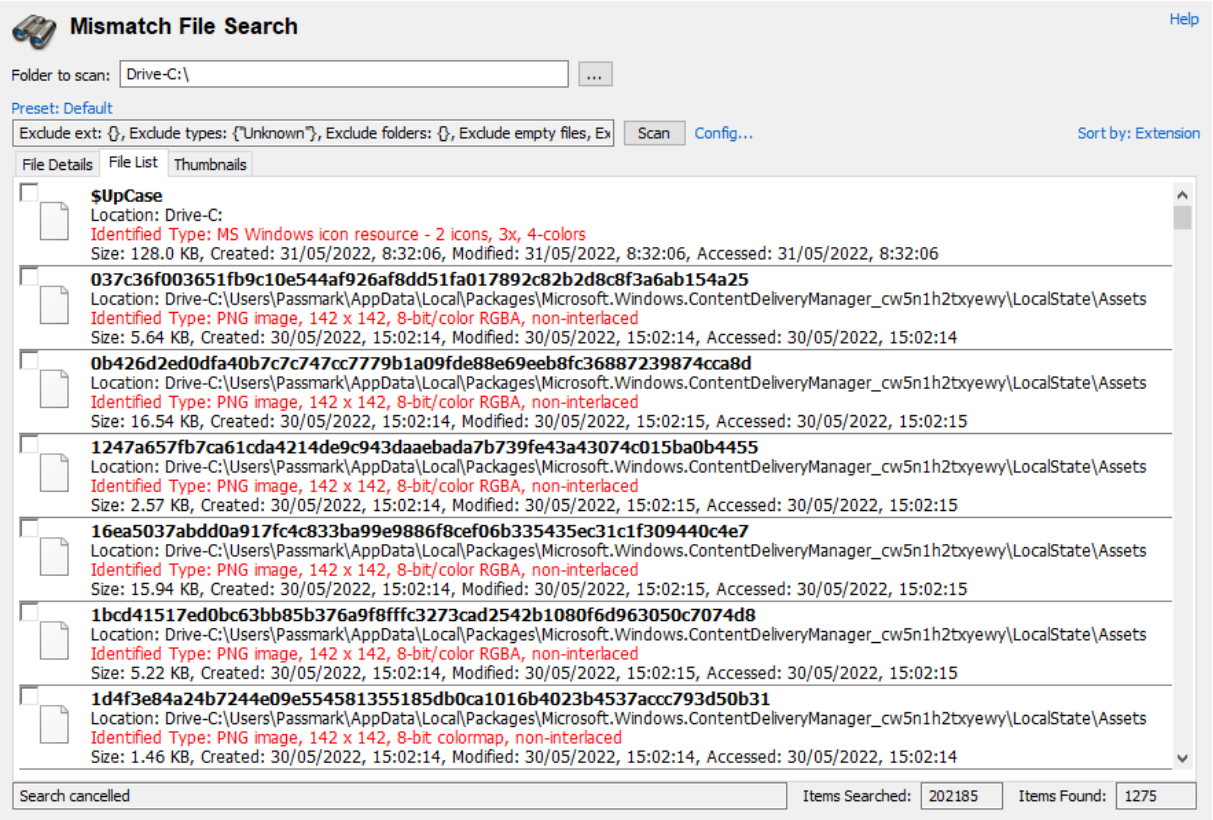


## Basic Usage

A basic mismatch file search simply involves entering a search location and a filter. OSForensics will locate any files whose raw bytes are not consistent with the format that the file extension specifies. For instance, an image file (test.jpg) that has been renamed to a document file (test.doc) will appear in the results since the raw bytes of an image file do not correspond to the file format of a document file.

**Preset**
The user can choose one of the following built-in filters or a user-defined filter.

> **Default** - Only known files whose file extension/contents that are mismatched are displayed
> **All** - The search results are filtered using all built-in filters
> **Inaccessible** - Only files that could not be accessed are displayed
> **Mismatch** - Files (including unknown files) whose file extension/contents that are mismatched are displayed

To create a new filter, click the *Config...* link.

## Results

The results of the search are displayed in one of several views, along with a summary of the number of items searched/found. Right-clicking a file opens the following context menu.

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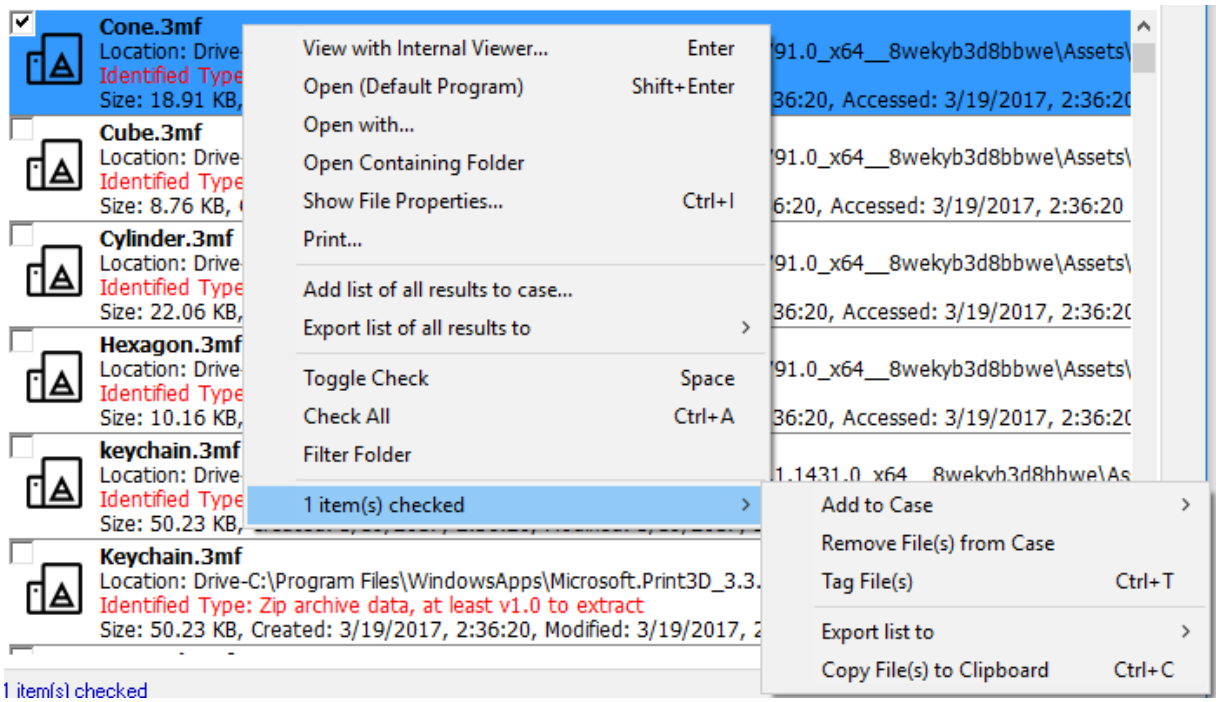


**View with Interval Viewer**
Opens the file with OSForensics Viewer to perform a more thorough analysis

**Open (Default Program)**
Open the file with the default program

**Open With...**
Allows the user to select the program to open the file

**Open Containing Folder**
Opens the folder than contains the file

**Show File Properties**
Opens the file with OSForensics Viewer in File Info mode.

**Print...**
Print the file (if applicable)

**Add Results to Case...**
Add the list of results as an HTML or CSV file to case

**Export Results to**
Export the list of results to a TXT, CSV or HTML file

**Toggle Check**
Toggle the check state of the selected item.

**Check All**
Check all the items in the list.

**Filter Folder**

Exclude the folder of the selected file from the search results

**n Item(s) checked**

**Add to Case**
Add the checked file(s) or list of checked file(s) to the case

**Remove File(s) from Case**
Remove the checked file(s) from the case

**Tag File(s)**
Tag file(s) for future reference. *Keyboard shortcut: Ctrl+T*

**Export list to**
Export the list of checked file(s) to a TXT, CSV or HTML file

**Save to disk...**
Save the checked file(s) to a location on disk.

**Copy Files(s) to Clipboard**
Copy the checked file(s) to clipboard. Once copied to the clipboard, the file(s) can be pasted to any other application that supports it (eg. Windows Explorer).

*Note: In some cases, copy and pasting files to an explorer window may fail without an error message when "preparing to copy". This may happen if the file has already been deleted (eg a temp file) or if Windows Explorer does not have permissions to access the files (eg restricted system files and folders). In these cases, it is better to use the "Add to case" function.*

## Advanced Usage

There are some files that can be edited in OSForensics that allow you to modify/improve the mismatch lookup process. See this page for details.

### 5.22.1 Mismatch Filter Configuration

The Mismatch Filter Configuration Window allows users to define new search filters. This window can be accessed by clicking on the "Config..." button in the main Mismatch File Search window.

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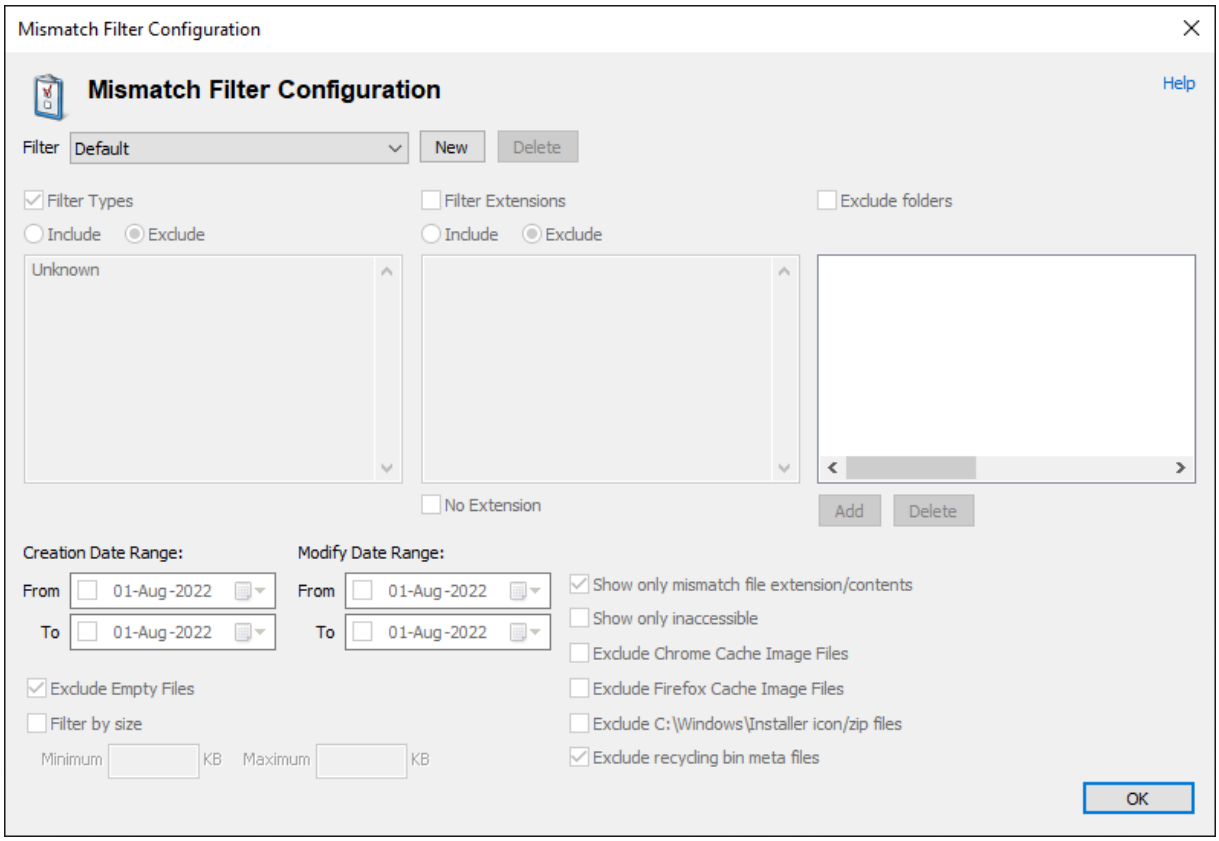
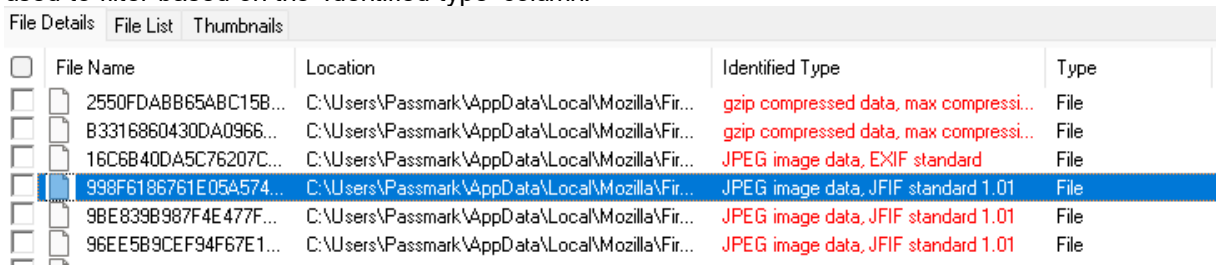



**Filter**
The selected filter to configure

**New**
Click this button to create a new filter

**Delete**
Click this button to delete the selected filter

**Filter Types**
If checked, allows the user to input filter types to include/exclude in the search results, Note: This is used to filter based on the 'Identified type' column:




For example, if you want to include/exclude the 'JPEG image data...' you can add that into the text box. You can also enter just part of the type e.g. 'image' and this will include/exclude all files with 'image' in its Identified type.

**Filter Extensions**
If checked, allows the user to input filter extensions to include/exclude in the search results. To include/exclude files with no extension, check the No Extension checkbox.

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**Exclude Folders**
If checked, allows the user to add folders to exclude from the search results. Click 'Add' to add a folder, 'Delete' to remove a folder.

**Only Include Date Range**
If checked, allows the user to specify the date ranges to include in the search results.

**Exclude Empty Files**
If checked, files that are 0 bytes in file size are excluded from the search results

**Exclude Recycling Bin Meta Files**
If checked, files that are 0 bytes in file size are excluded from the search results

**Filter by size**
If checked, allows the user to specify file size limits for search results. The user may enter either a minimum, maximum, both or neither. The only restriction is that the maximum must be larger than the minimum.

**Scan browser cached images only**
If checked, it will perform a scan of browsers (Chrome, Edge, Opera, Firefox) cache directories to search for image files.
This option will ignore the Filter Types and Filter Extensions fields typed by users manually.

Examples of cache locations:
Chrome: C:\Users\[Username]\AppData\Local\Google\Chrome\User Data\Default\Cache\Cache_Data
Edge: C:\Users\[Username]\AppData\Local\Microsoft\Edge\User Data\Default\Cache\Cache_Data
Opera: C:\Users\[Username]\AppData\Local\Opera Software\Opera Stable\Cache\Cache_Data
Firefox: C:\Users\[Username]\AppData\Local\Mozilla\Firefox\Profiles\[Profile]\cache2\entries

The file will be added to the list-view if the identified type contains a keyword "image".
It will scan all the devices added the case by default, if no case has been detected, then the current device entered in the Mismatch Files Search main dialog will be scanned.

One known limitation for investigators to use this feature for the browser cached images search is that it won't scan the data inside the data files, such as file "data_3" may contain data of several images and OSF Mismatch Files Search will not display them.

**Show only file extension/contents**
If checked, the search results will only contain files whose contents and file extension are mismatched.

**Show only inaccessible**
If checked, the search results will only contain files that cannot be accessed.

**Exclude Chrome Cache Image Files**
If checked, search results will not include Chrome Cache image files in the below directory:

```
..\AppData\Local\Google\Chrome\User Data\Default\Cache\*
```

**Exclude Firefox Cache Image Files**
If checked, search results will not include Firefox Cache image files in the below directory

```
..\AppData\Local\Mozilla\Firefox\Profiles\[profile]\Cache*
```

**Exclude c:\windows\installer icon/zip files**

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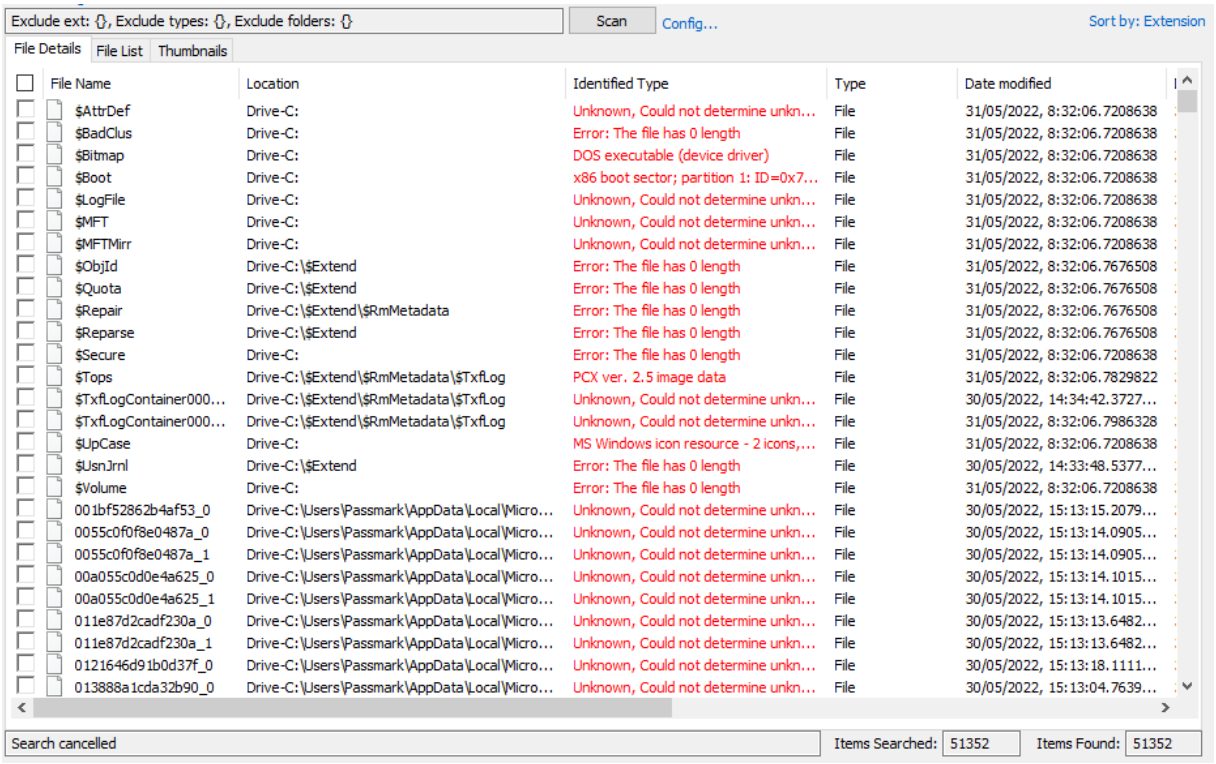
If checked, the search results will not include icon/zip files under c:\windows\installer

### 5.22.2 Mismatch File Search Results View

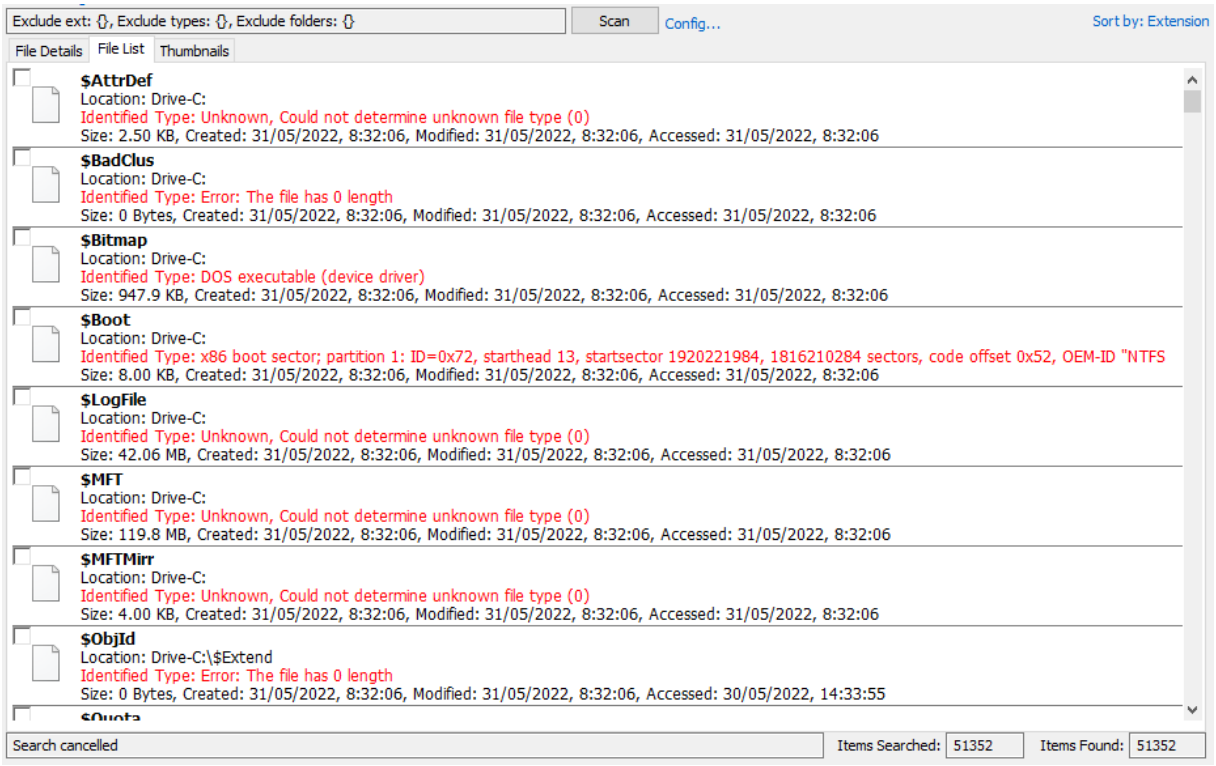
The user may view the mismatch file search results in one of several views.

## File Details View



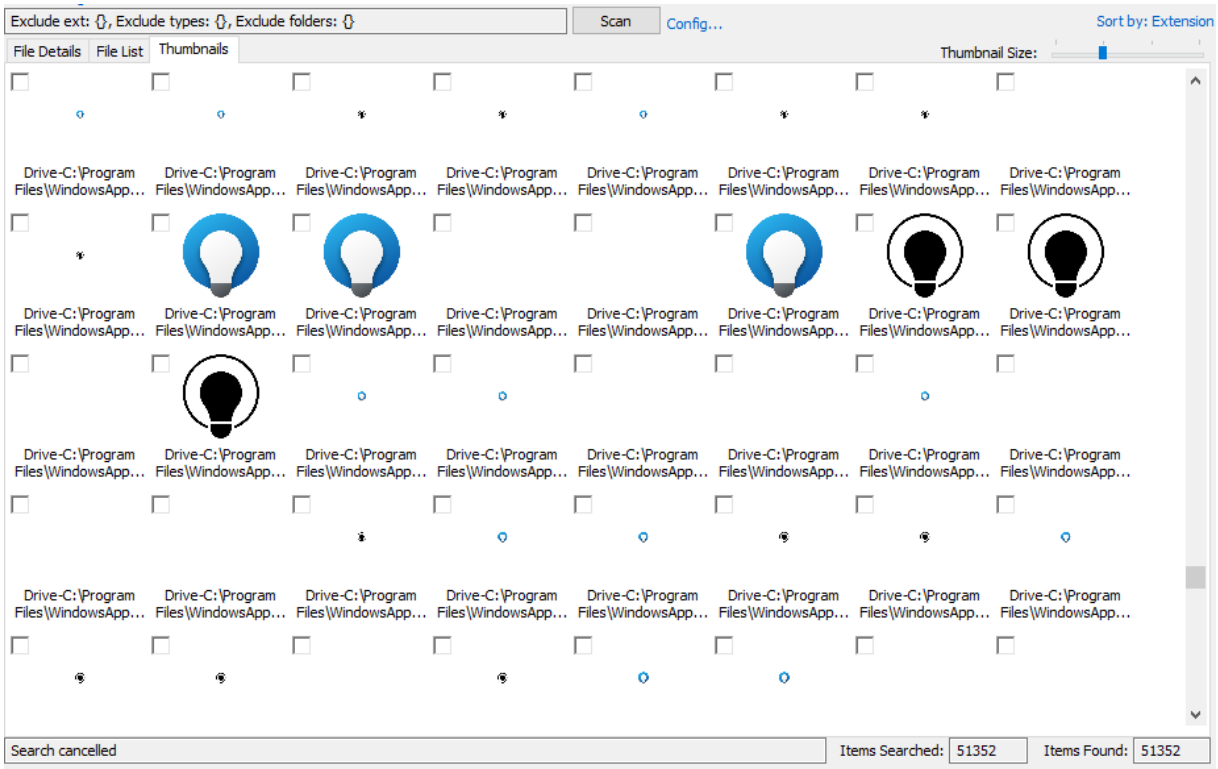

The File Details View displays the search result in a table format, listing the file names along with relevant attributes and metadata.

## File List View




The File List View displays the search result as a list of file names, along with the supposed file type, corresponding metadata and icon. The results are sorted according to the criteria selected in the Sorting combo box.

## Thumbnails View




The Thumbnails View displays the search result as a list of thumbnails as well as with its file path. This view is useful when the search results contain media files, allowing the user to quickly browse through the thumbnail images. Similar to the File List View, the results can be sorted via the Sorting combo box. The size of the thumbnails can be adjusted using the Thumbnail Size slider bar.

### 5.22.3 Advanced

There are two files that can be modified to change the behaviour of the Mismatch File search. Editing these files should only be done by advanced users. The files can be found in your common application data folder (ie. 'C:\ProgramData' or 'C:\Documents and Settings\All Users\') under 'Passmark\OSForensics'.

#### OSF.mg

This file contains the definitions used to identify file types, essentially containing templates showing what different types of files look like.

The file contains lines describing magic numbers which identify particular types of files. Lines beginning with a > or & character represent continuation lines to a preceding main entry:

>
If file finds a match on the main entry line, these additional patterns are checked. Any pattern which matches is used. This may generate additional output; a single blank separates each matching line's output (if any output exists for that line).

&
If file finds a match on the main entry line, and a following continuation line begins with this character, that continuation line's pattern must also match, or neither line is used. Output text associated with any line beginning with the & character is ignored.

Each line consists of four fields, separated by one or more tabs:

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Field 1

The first field is a byte offset in the file, consisting of an optional offset operator and a value. In continuation lines, the offset immediately follows a continuation character.

If no offset operator is specified, then the offset value indicates an offset from the beginning of the file.

The * offset operator specifies that the value located at the memory location following the operator be used as the offset. Thus, *0x3C indicates that the value contained in 0x3C should be used as the offset.

The + offset operator specifies an incremental offset, based upon the value of the last offset. Thus, +15 indicates that the offset value is 15 bytes from the last specified offset.

An offset operator of the form (l+R) specifies an offset that is the total of the value of memory location specified by l and the value R.

An offset operator of the form (l-R) specifies an offset that is calculated by subtracting the value R from the value of memory location specified by l.

Field 2

The next field is a type: byte, short, long, string, Ustring (Unicode string). byte, short, long, beshort (big endian short), leshort (little endian short), belong (big endian long), lelong (little endian long). This can be followed by an optional mask which is bitwise ANDed to the value prior to comparison, for example, byte &0x80 looks at the high bit.

Note:
The types beshort and belong are equivalent to short and long, respectively.

Instead of a type, this field can contain the string search/N which indicates to search for the string indicated in the next field up to N byes from the offset.

Field 3

The next field is a value, preceded by an optional operator. Operators only apply to non-string types: byte, short, long, leshort, beshort lelong, and belong. The default operator is = (exact match). The other operators are:

= equal
! not equal
> greater than
< less than
& all bits in pattern must match
^ any bits in pattern may match
x or ? any value matches (must be the only character in the field)
(? is an extension to traditional implementations of magic)

string or Ustring values to be matched may contain any valid ANSI C backslash sequence. Thus, to match a single backslash, \\ must be entered in the magic file.

Note:
Due to its format, the magic file must use a \t to match a tab character.

Field 4

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The rest of the line is a string to be printed if the particular file matches the template. Note that the contents of this field are ignored, if the line begins with the & continuation character. The fourth field may contain a printf-type format indicator to output the magic number (See printf for more details on format indicators).

**External Links**
Above documentation taken from http://www.mkssoftware.com/docs/man4/magic.4.asp
Wikipedia entry on Magic Numbers http://en.wikipedia.org/wiki/File_format#Magic_number
Database of additional magic definitions http://www.magicdb.org/

### MagicLookup.csv
This file defines the list of extensions 'known' by OSForensics. This file is a comma separated table with three columns, each line defines a new known file type. The first column defines a substring of the data type returned by the lookup. The second column defines the extension associated with this file description. The third column is contains additional flags defining this record. Currently the only supported flag is 1, which specifies that this type of file does not only belong to this extension.

Examples:

```
RAR archive data,rar,0
```

The first line specifies if the type contains the text 'Rar archive' then the extension should be 'rar'. The flag is 0 meaning that any file with an extension that isn't 'rar' is mis-labeled.

```
Text,htm,1
Text,txt,1
```

These two lines specify that files that have been identified as with 'Text' in their description can be either 'htm' or 'txt'. The '1' specifies files with other extensions that are text files are not necessarily mis-labeled.

## 5.23 Passwords

### Find Passwords/Keys
Retrieve passwords and product keys that have been stored by various applications and web browsers on the system.

### Windows Login Passwords
Retrieve login passwords and hashes for the users of the system. Retrieved hashes can be used in conjunction with rainbow tables to find passwords.

### Rainbow Tables
Use rainbow tables to do a reverse lookup on a password hash.

### File Decryption & Password Recovery
Decrypt and access encrypted files.

### Install PFX Certificate
Install a PFX certificate so Windows EFS files can be decypted and opened.

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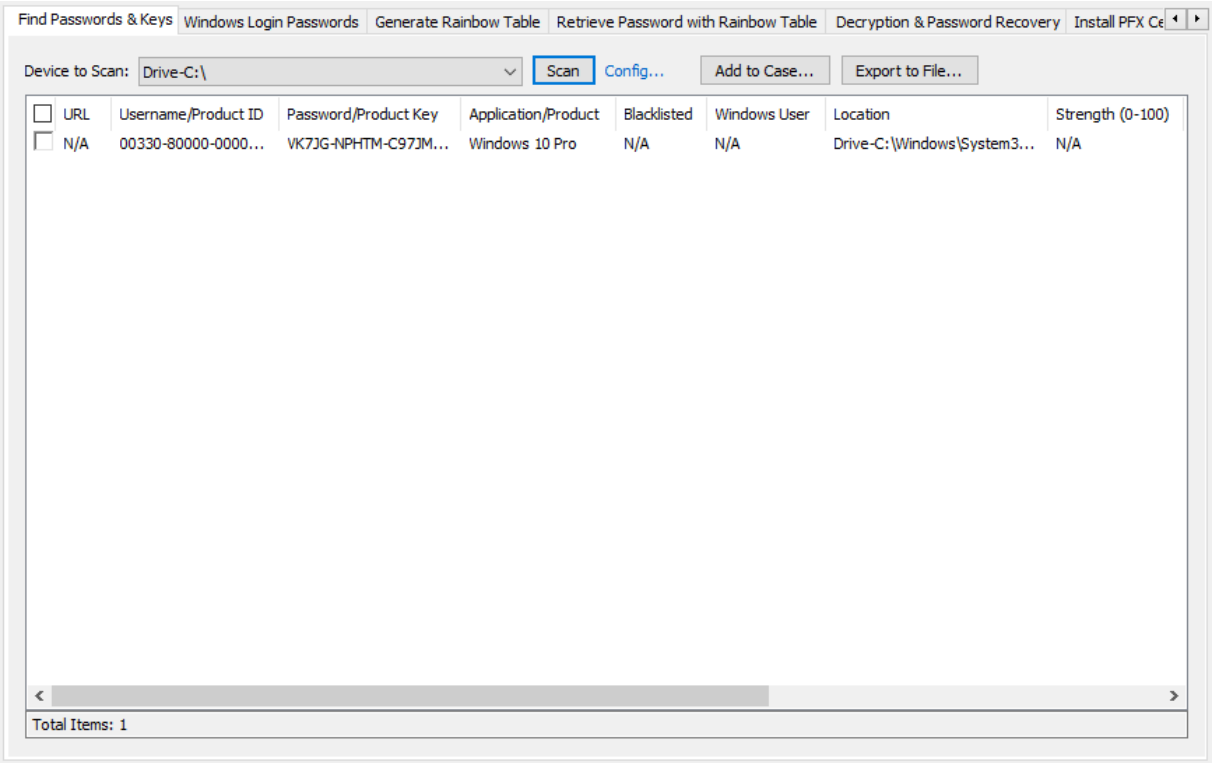
### 5.23.1 Find Passwords/Keys

This feature can recover passwords for several types of applications, as well as Microsoft product keys.




## Artifacts Extracted

1. **URL** - This column contains the URL that browser passwords were used for. For non-browser passwords and product keys, this field does not apply.
2. **Username/Product ID** - This is the username or login that a password is associated with. For product keys, this column will contain the product ID instead.
3. **Password/Product Key** - This contains the plaintext password or product key.
4. **Application/Product** - This column contains the type of password that was extracted (see below for a list of applications), or in the case of a product key, it contains the name of the product the license key is for.
5. **Blacklisted -** These are websites for which a user has selected to never save a password for. In this case only the website visited will be displayed and no password.
6. **Windows User -** This contains the Windows user to which the login information is associated.

**Browser Passwords**
Passwords that been saved by users into their web browsers (IE, Edge, Firefox, Safari, and Opera). It can also find sites where a user has chosen not to remember a password.
Note: to recover FireFox password you must have FireFox installed on either the system that is running OSForensics or on the drive that OSForensics is currently scanning.

**Email Passwords**
Passwords saved by email account managers (Outlook and Windows Live Mail).

**Wifi Passwords**

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Passwords for connecting to Wi-Fi networks that have been saved on the system.

**Windows Autologon Password**
Passwords that were provided for autologon of a particular User account when logging into Windows. When autologon has been enabled (e.g. by using netplwiz) and the password has been set, that password is saved on the system. Another way in which this value gets saved is when a password is provided during Windows installation, in some versions of Windows, it gets saved as the Autologon password even though Autologon is not enabled. Note that this password does not necessarily have to be the correct value, as it is still possible to set this value to an incorrect password (e.g. via netplwiz).

**Windows Product Key**
Product keys for certain versions of Windows, Microsoft Office, and Visual Studio.

**Supported applications**
Below is a table that shows which features are supported for different applications and their different versions.

| Password Type | Versions | Login & Passwords |
|---|---|---|
| Windows Autologon Password | 3,4,5,6+ | Yes |
| Wifi | Vista, Win7, Win8, Win10 | Current user **OR** when Windows user password is available* |
| Outlook | 2002, 2003, 2007, 2010, 2013, 2016 | Current user **OR** when Windows user password is available* |
| Outlook | Express, 98, 2000 | Current user only* |
| Windows Live Mail | 12, 2009, 2011, 2012 | Current user only* |
| Chrome | 8 | Current user **OR** when Windows user password is available* |
| Internet Explorer | 6,7,8 | Current user **OR** when Windows user password is available* |
| Edge | 20+ | Current user only* |
| FireFox | 2 | Current user only* |
| FireFox | 3,4,5,6+ | Yes |
| Safari | 4 | No |
| Opera | 20+ | Current user only* |
| Opera | 10, 11+ | Yes |
| Opera | 9 | Yes |

| Product | Versions | Product Keys |
|---|---|---|
| Windows | Vista, 7, 8, 10 | Yes |
| Microsoft Office | 2003, 2007, 2010, 2013, 2016 | Yes |
| Visual Studio | 2008, 2010 | Yes |

*Current user only: This means information can only be retrieved with the Windows user to which the account belongs to. That is, you must be logged in to that Windows user when retrieving the password.

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*Current user **OR** when Windows user password is available: This means that in addition to being available in the above circumstances, these passwords are also available for retrieval in an Offline manner, but only when the Windows User password that was used to decrypt the unknown password is available (e.g. by extracting the Windows Autologon password) or is provided by the investigator (i.e. in the Config window).

#### 5.23.1.1 Offline Password Decryption

When retrieving passwords from an offline Windows installation (i.e. not a Live Acquisition) it is recommended that you provide the password of the Windows user account that is being investigated. To set the password, open the Config window, select "Enter Windows User Login" and type in the Username and Password of the Windows account that you wish to retrieve passwords from (see Fig 1. below).

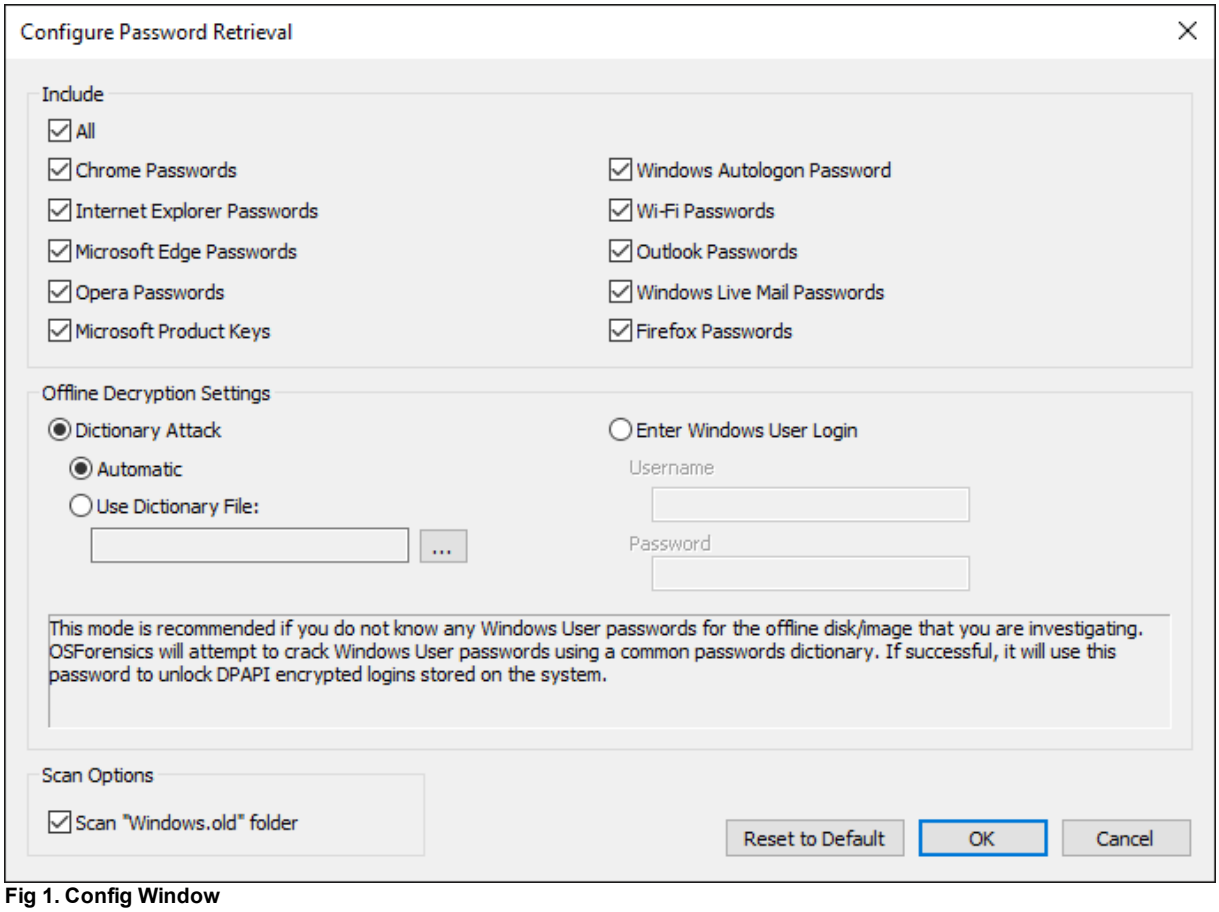


**Fig 1. Config Window**

For many applications supported in this module, the Windows User password is required to retrieve passwords in an offline manner. This includes passwords for applications such as Chrome, IE, and Outlook. The user password is required because these applications save login information as encrypted data on the disk, and the key required to decrypt the data is the Windows User password.

If no Windows User password is provided, the default "Dictionary Attack" mode will be used. Here, OSForensics will automatically check if a password has been saved as the Autologon password and will attempt decryption using this password. Note that the Autologon password is also displayed by default in the list of retrieved passwords. The caveat is that this value is not always correct, nor always available, and it only applies to the user account that has been specified for autologon.

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In addition to attempting decryption using the Windows Autologon password, a quick dictionary attack will be performed in which a list of common passwords will be tested. Alternatively, you can also specify a dictionary file to use.

Note that while this function searches each Windows user account on the system, you may only provide one user account password at a time.

**If you do not know the Windows user password, you can try obtaining it with the following steps:**

1. Use the Windows Login Passwords tab to dump the NTLM (a.k.a. NT) hash (or LM for WinXP) and save it to a file.
2. Obtain a decently sized NTLM Rainbow Table or collection of NTLM Rainbow Tables. Rainbow Tables are available for download from various sources, including our website. A hard drive containing a large collection of rainbow tables is also available for purchase at http://www.osforensics.com/rainbowtables_hashsets.html. You may also try generating one, but generating an effective rainbow table will require a lot of resources. Make sure you obtain rainbow tables that are compatible with OSForensics.
3. Use the Retrieve Password with Rainbow Table tab to crack the NTLM hash that was dumped in step 1. If this fails, try using a rainbow table with a different or larger character set. If the Rainbow table you used did not have a high success rate, try using one with a higher success rate.
4. Once you have obtained the password in plaintext, open the Config window, select "Enter Windows User Login" and enter the Username and Password that you have just recovered (see Fig 1. below). Click "OK" and then click "Retrieve Passwords". If you are still unable to decrypt passwords, it may be because it is under a different user account to the one that you entered in the Config window.

### 5.23.2 Windows Login Passwords

This will attempt to retrieve the LM and NT hashes from the Windows registry and save them to a file so Rainbow Tables can be used to match the hash values to a password. In some cases the password may be retrieved by OSForensics without the use of Rainbow Tables, for example where the password is the same as the username or it exists in the common passwords dictionary.

Any cached domain user names and passwords hashes will also be retrieved and displayed separately.

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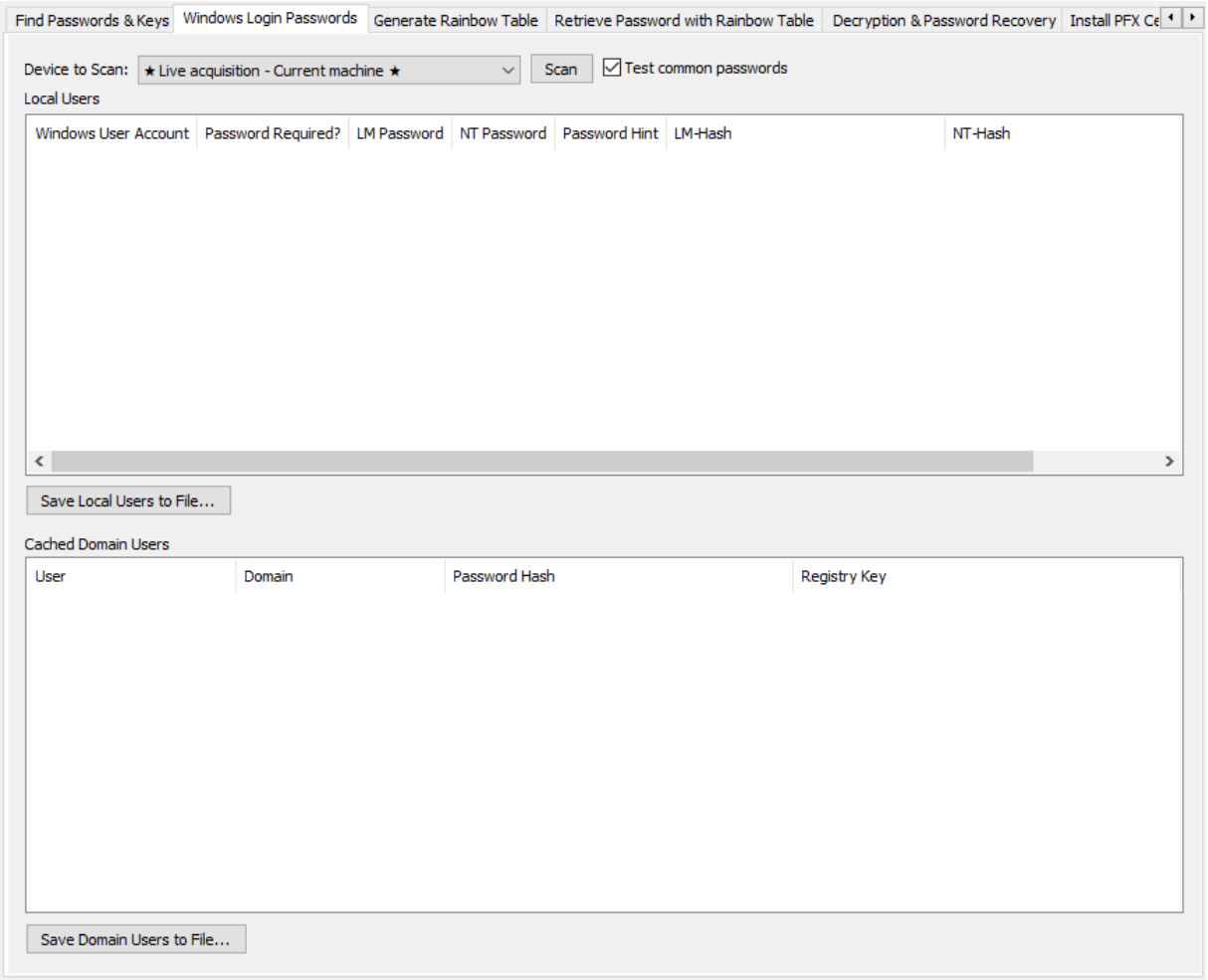


**Test Common Passwords**
Selecting this option will test the found local user hashes against the common passwords dictionary file that is included in the OSForensics install.

**Save Local Users to File**
Saves the local user hashes in PWDUMP format (username:userid:LM hash:NT hash:comment:blank) so they can be used in conjunction with Rainbow Tables in OSForensics to find the passwords.

**Save Domain Users to File**
Saves the cached domain hashes so they can be used with external tools to find the passwords.

Once the registry files have been read the information will be displayed like the example below;

**Local Users**
Windows User Account: The Windows login user name
Password Required?: Whether a password is required to login.
LM Password: The password that matched the LM hash, if found, otherwise will contain "(unknown)" or "(disabled)". If blank then there is no password (an empty password).
NT Password: The password that matched the NT hash, if found, otherwise will contain "(unknown)" or "(disabled)". If blank then there is no password (an empty password).
LM-Hash: The LM hash that was retrieved from the registry or "(disabled)" if there was no hash.

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NT-Hash: The NT hash that was retrieved from the registry or "(disabled)" if there was no hash.
Registry Key: The registry key location the data was retrieved from.

**Domain Users**
User: The user name.
Domain: The domain logged into.
Password hash: The stored password hash.
Registry Key: The registry key location the data was retrieved from.

#### 5.23.2.1 Recovering Windows Passwords With Rainbow Tables

Once the hashes have been recovered Rainbow Tables can be used to try to find the password that matches the hash value. For this example we're using a rainbow table that was generated in OSForensics using "lm" as the hash setting, minimum 1 to maximum 7 characters and a character set of uppercase alpha-numeric (A-Z 0-9). This table is available for download from the OSForensics website.

First we need to retrieve the hash values from the registry and save them to a file, we are using a hard drive that had Windows XP installed on it. Opening the file in a text editor will let us select individual hashes to use with the Rainbow Tables if we were only trying to find a single value. If looking for multiple passwords then we can import the entire file on the Rainbow Table tab.

Once we have selected the file we need to choose the table to use and then start the process with "Recover Password/s".

If the values for the LM hash are all "(disabled)" this would indicate that either the LM hash has been disabled as part of a security policy for that Windows install or a password that is tool long for a LM hash has been used (15 or more characters).

For more information on LM and NT hashes see these Wikipedia articles.

### 5.23.3 Generating Rainbow Tables

This window is used for generating Rainbow Tables. These tables can then be used in the Rainbow Table Password Recovery Window.

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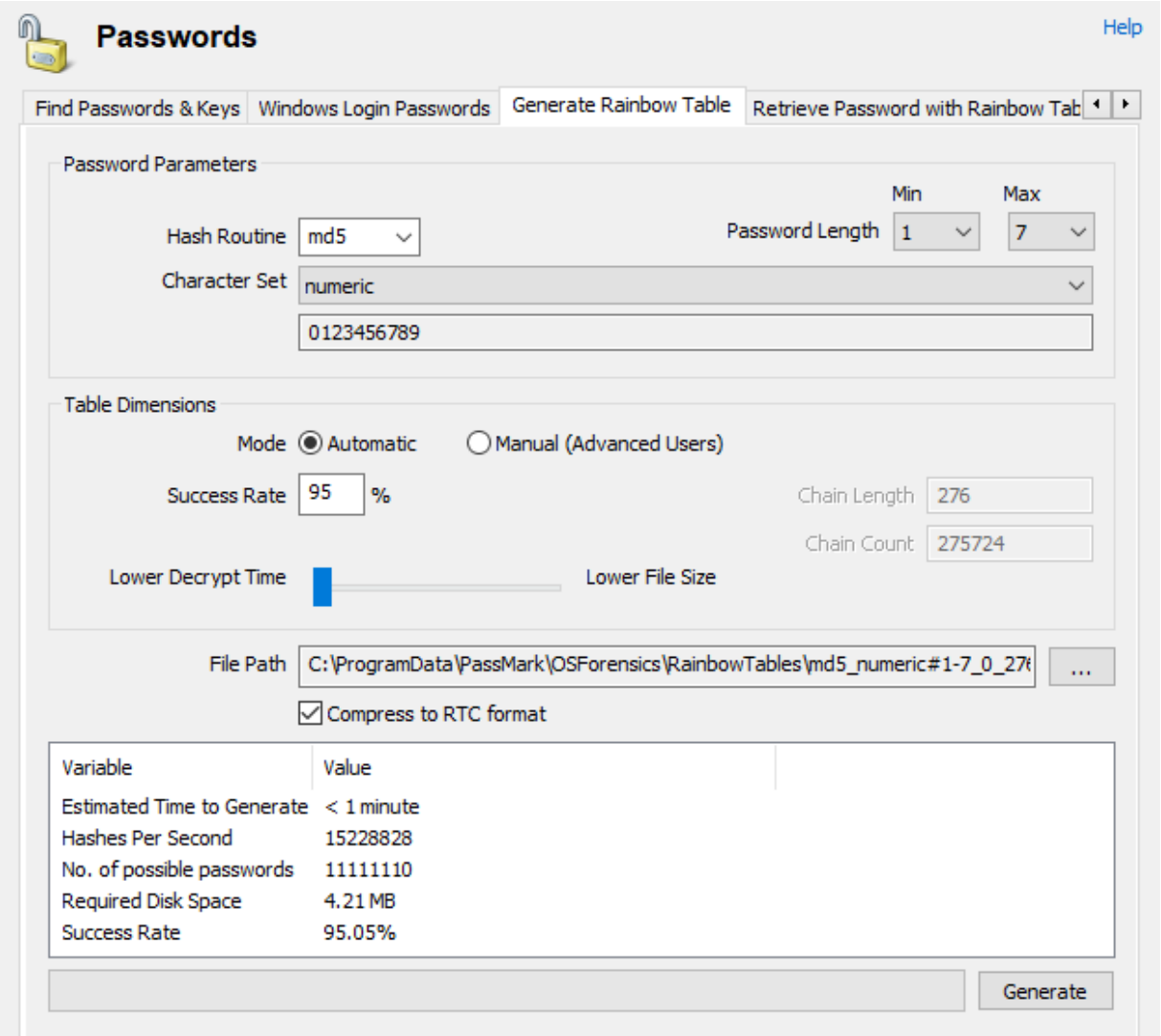


To generate a **Rainbow Table**, fill in the input fields with the appropriate values under the Password Parameters box..

Under the **Hash Routine** field, select the hash routine that was used to encrypt the password into a hash. Currently, there are four hash routines to choose from, **md5**, **lm, ntlm,** and **sha1**.

Under the Password **Length** fields, select the suspected minimum and maximum length of the password.

Under the **Character Set** field, select the character set that contains the characters that the password is most likely to contain. The elements of the character set are listed in line following the name of that character set. For example, the character set "loweralpha" contains the lowercase letters of the alphabet.
Note: The size of the character set (i.e. the number of characters in that character set) will effect the efficiency of the recovery process. To decrease generation time, try to pick the smallest character set that also covers the possible characters of the password.

Before proceeding, use the **Automatic** and **Manual** radio buttons to select the input mode you would like to use in the Table Dimensions box. If you wish to input a success rate and have the dimensions

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calculated automatically, then select Automatic mode. Otherwise, if you wish to input the table dimensions (chain length and chain count) then select Manual mode.

**Automatic mode**

Under the **Minimum Success Rate** field, input the minimum success rate of recovering the password that you are willing to tolerate. A higher success rate will result in tables that are increasingly longer to generate, so the value should be as conservative as possible. The dimensions of the **Rainbow Table**, i.e. the **Chain Count** and **Chain Length** fields, will be filled out automatically. You can continue to adjust the **Chain Count** and **Chain Length** by using the Slider Control bar to achieve a desired balance between minimizing the decryption time and minimizing the file size. To begin generation, click the "Create Rainbow Table" button. Once generation has commenced, the process can be terminated by clicking "Cancel".

**Manual mode**

Fill in the **Chain Count** and **Chain Length** fields. If you are unsure about what these values mean, then it is recommended that you use **Automatic mode**. The Rainbow Table statistics will be calculated and displayed automatically. Increasing the size of the Rainbow Table will increase the generation time proportionately. Increasing the size also increases the success rate, but at a decreasing rate. Increasing the Chain Count will increase the Rainbow Table file size proportionately, while Increasing the Chain length will have no effect on the file size, but will increase the expected decryption time. To begin generation, click the "Create Rainbow Table" button. Once generation has commenced, the process can be terminated by clicking "Cancel".

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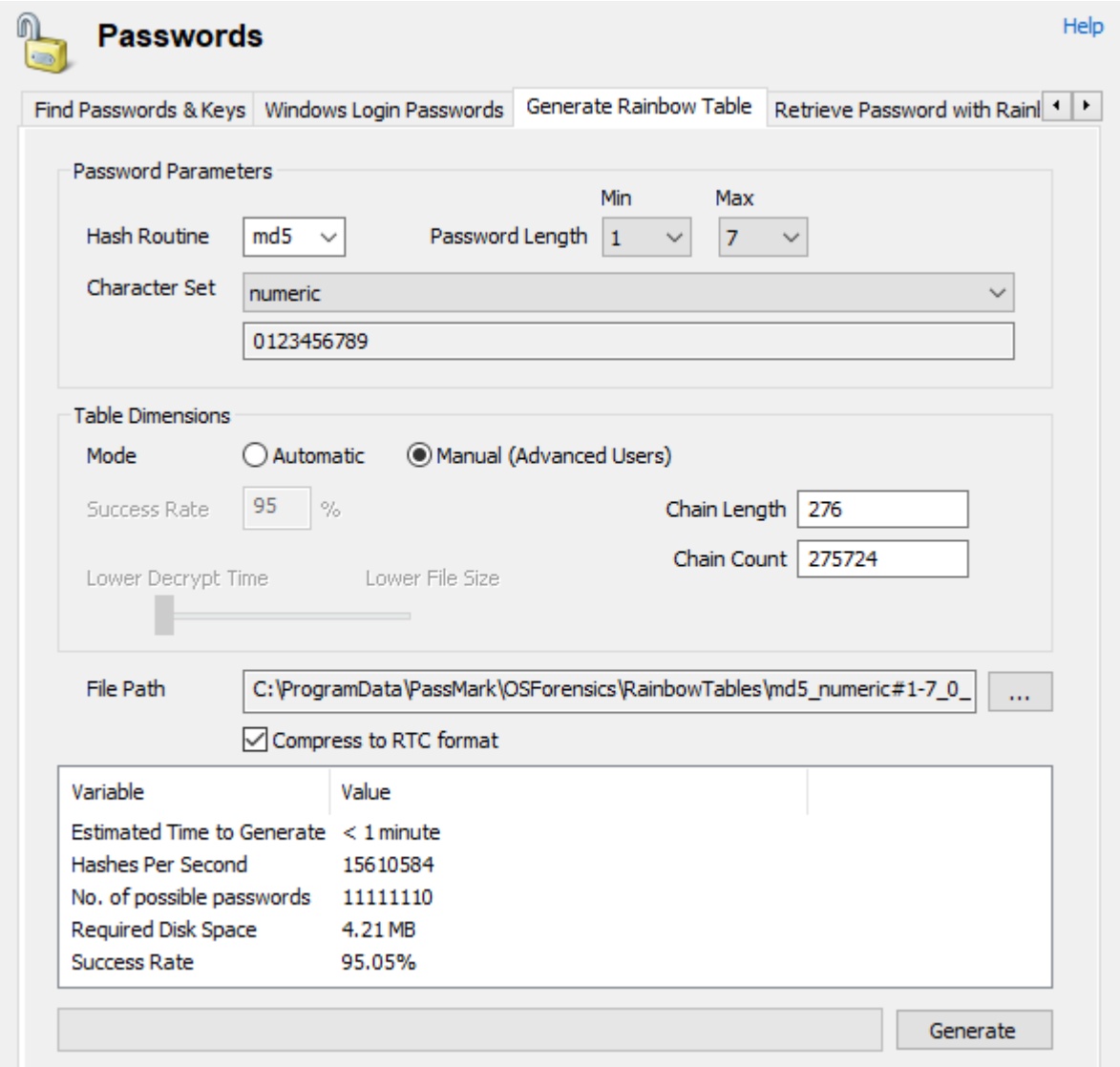


## File Naming

By default, a file name is given that denotes all the parameters of the Rainbow Table and generated Rainbow Tables will be saved in the OSForensics working folder under a folder named "RainbowTables". The default file name contains the parameters necessary to use the Rainbow Table for password recovery, and the default folder is also the folder used to populate the list of Rainbow Tables in the Recover Password feature. The save folder can be changed by clicking the "Save to folder..." button, but it is not possible to change the file name from the interface, as this is discouraged. If it is necessary to alter the filename, this can be done from explorer. If any parameter except the suffix is altered, the table will no longer be compatible with OSForensics. For more information on the file name convention used. please see File Naming Convention.

Note that if a Rainbow table of the same parameters is generated multiple times and saved in the same folder, OSForensics will assign a unique Rainbow table Index to the rainbow table so that the rainbow table is different from those previously generated.

## RTC Format

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RTC stands for Rainbow Table Compact. They are the result of .RT (raw rainbow table) files that have been compressed to save space. Since the raw data has been altered, they generally take a slightly longer time to extract passwords from. By default, OSForensics compresses rainbow tables to RTC format. This feature can be turned on/off simply by switching the "Compress to RTC format" checkbox.

#### 5.23.3.1 Rainbow Tables

## What are rainbow tables

Rainbow tables are tables of plain text passwords and hashes. They allow a password to be quickly looked up if a hash for that password is known.

**What is a hash?**
Passwords are generally not stored as plain text. Instead, passwords are stored as the output of a cryptographic hash function and the plain text password is discarded. Hashes are one-way mathematical operation, so the hash can be verified from a login page but can't be reversed in theory. A password in plain text is given as input and a hash is created as output.

**Plain text password input:** TopSecret$89
**MD5 Hash:** FB34E3347894B0BA8AC2F34F56851095

Even if an attacker gained access to the hashed version of a password, it's not possible to directly reconstitute the password from the hash value alone. Common hashing algorithms have names like MD5, SHA1, SHA256.

**Methods to recover the password?**
Assuming the hashed password is known, or can be found on the system then there are 2 methods to recover the password. One is a brute force attack where every possible password is attempted until a match is found. This can be extremely slow, especially if it needs to be repeated for multiple hashes. The second method is to use a pre-computed table of hashes to speed up the process, known as rainbow tables.

**Password space**
With even short passwords there can be a lot of possible combinations, depending on the character set used. For example

**Character set:** A-Z
**Password length:** 1 to 7 character
**Number of possible passwords:** 8,353,082,582

**Character set:** A-Z and a-z and 0 to 9
**Password length:** 1 to 12 character
**Number of possible passwords:** 1,000,816,264,331,497,152

**Rainbow table format**
If every password and hash were stored in a file, the file would be enormous. Too large to be practical in fact. So instead of storing all possible hashes the data is divided up into "hash chains". A hash chain is a sequence of hashes where each hash in the chain is generated from the prior hash. Only the beginning and end of the chain are then stored in the rainbow table. Dramatically reducing the size of the file, but also increasing the time required to look up the file (as the chains need to be regenerated

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during the lookup process). So there trade off to be made in terms of file size, completeness of the table, lookup time and generation time.

Despite the optimisation of the table format, rainbow tables can still be very large. 500MB to several GB per table are common.

For each combination of hash algorithm, password lengths and character set a different rainbow table is required. So a MD5 table will only work on passwords encrypted with the MD5 algorithm. The smaller the password space, the smaller the table can be. Also not all possible hashes are generally stored in a table, so there is also a concept of success rate. A table with a 90% success rate can be expected to decrypt 9 out of 10 hashes. The higher the required success rate, the larger the table.

**When rainbow tables won't work**
Rainbow tables won't work, or are not practical, in the following situations.

1) The Password was encrypted with an unknown algorithm
2) The possible password length is long e.g. 12 characters or more
3) An unknown or random 'salt' is added to the password before hashing

It is also worth noting that no modern properly implemented password scheme is vulnerable. But there are still older, not so well implemented schemes, that are subject to attack.

**Some common applications that use hashes**
**LM hash**, an older hash algorithm used by Microsoft. LM hash is particularly vulnerable because passwords longer than 7 characters are broken into two sections, each of which is hashed separately. http://en.wikipedia.org/wiki/LM_hash

**MySQL** user accounts are listed in the user table of the mysql database. Each MySQL account is assigned a password, although what is stored in the Password column of the user table is not the plaintext version of the password, but a hash value computed from it. Password hash values are computed by the SQL PASSWORD() function. Prior to MySQL 4.1, password hashes computed by the PASSWORD() function are 16 bytes long. Such hashes look like this:

```
mysql> SELECT PASSWORD('mypass');
+--------------------------------------------+
| PASSWORD('mypass')                         |
+--------------------------------------------+
| *6f8c114b58f2ce9e                          |
+--------------------------------------------+
```

As of MySQL 4.1, the PASSWORD() function has been modified to produce a longer 41-byte hash value:

```
mysql> SELECT PASSWORD('mypass');
+--------------------------------------------+
| PASSWORD('mypass')                         |
+--------------------------------------------+
| *6C8989366EAF75BB670AD8EA7A7FC1176A95CEF4  |
+--------------------------------------------+
```

The Microsoft Windows NT/2000 family uses the LAN Manager and NT LAN Manager hashing method and is also unsalted, which makes it one of the more popularly generated tables.

## Additional Information
Generating Rainbow Tables
Recovering Passwords Using Rainbow Tables
.RT Naming Convention

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5.23.3.1.1 Compatible File Formats

OSForensics is fully compatible with .RT and .RTC, and partially compatible with .RTI file formats as long as the file name follows the correct naming convention.

OSForensics can generate and extract passwords from .RT and .RTC files.

OSForensics can extract passwords from .RTI files. OSForensics. RTI tables are available for download online at http://www.freerainbowtables.com/tables/.

**RT Format**

.RT files contain the raw values of the start and end points of each chain in a rainbow table. Each start and endpoint is an unsigned 64-bit integer value, and are also referred to as indexes. Chains are stored in ascending order with respect to their end point value.

Below is an example of a few rainbow chains in little endian.The start indexes are in purple and the end indexes are in blue.

```
000000000h: D2 0B 0E 00 00 00 00 00 91 06 00 00 00 00 00 00
000000010h: FA 2D 0E 00 00 00 00 00 9D 06 00 00 00 00 00 00
000000020h: CE 06 09 00 00 00 00 00 AD 06 00 00 00 00 00 00
000000030h: AB 03 04 00 00 00 00 00 AE 06 00 00 00 00 00 00
```

**RTC Format (Rainbow Table Compact)**

RTC Format is a compact version of RT format. It aims to save space by approximating the sorted end point values to a linear function, storing the parameters to this function in the header, and storing the error of each value to the linear function in place of the raw value. The number of bytes allocated to the start and end values of each chain is minimized and is stored in the header.

The advantage of RTC format over RT format is that it can potentially save a considerable amount of space. However, it is a generally slightly slower than RT format, due to the overhead of inverting the stored values back to the raw values.

**RTI Format (Rainbow Table Indexed)**

RTI Format is essentially and indexed version of RT format. RTI Format aims to saves space and increase search speed by indexing chains for every increase 2^16 (2 byte) increase in the end point values. The prefix (5 bytes) of each index entry, along with an additional 6 bytes is stored in the .rti.index file. For each chain, 6 bytes is given to the start point value, while 2 bytes are given for the suffix values of the end points. It is implied that start points values will lie within the 6 byte range and end points will lie within the 7 byte range.

5.23.3.1.2 File Naming Convention

Rainbow Table files in .RT, .RTC and .RTI format should follow a specific naming convention in order to be compatible with **OSForensics**. When Rainbow Tables are generated in **OSForensics** they will be given a default name (unless otherwise specified) that will follow this naming convention:

*hashAlgorithmName_characterSetName_#minimumPasswordLength-maximumPasswordLength_RainbowTableIndex_ChainLength_ChainCount_OSF*.rt*

For example:

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"md5_alpha-numeric#1-5_0_20288x182592_OSF.rt"

5.23.3.1.3 How Chains are Generated

Rainbow tables are made up of chains of plaintext - hash pairs which we will refer to as 'rainbow chains'.

## Generating the Chain

A rainbow chain is generated by producing a series of plaintext-hash pairs.

plaintext -> hash -> plaintext -> hash -> ... -> hash -> plaintext

The start of the rainbow chain, is a plaintext string that is generated randomly. To obtain a hash from a plaintext, the hash algorithm being used is applied to the plaintext. What isn't so obvious, is how to obtain the next plaintext. A mathematical function called a reduction function is applied to the hash to obtain the subsequent plaintext in the chain. The reduction function is essentially arbitrary, and can be defined in any way, as long as the same reduction function/s is used for the cracking process.

In a rainbow table, a different reduction function is used for each column, to avoid Rainbow Chains containing the same information.

This implementation uses a reduction function based on RainbowCrack 1.2. The reduction function is defined as follows:

f(hash) = (hash + i) % plaintext_space

where
i = the column number of the hash
plaintext_space = the plaintext space which is the total number of possible plaintexts/passwords given by the character set and the minimum and maximum plaintext lengths

This reduction function is suitable, because it is linear and can be computed fast.

A hash is usually represented by a hexadecimal number, is therefore essentially an integer, making it a suitable input for the reduction function. However the output will not immediately produce a plaintext. Thus there is an intermediate value, called an **index** that is produced by the reduction function. An index is simply an integer that corresponds to a plaintext/password. So in reality, a rainbow chain looks something like this:

**index**->plaintext->hash->**index**->plaintext->hash->...->hash->**index**

An index can be thought of, as an integer representation of a plaintext, in which the value of each plaintext depends on the character set and the plaintext space. For example, suppose we had a character set given by [abc] and a min/max plaintext length of 1. This would give us 3 possible passwords {a,b,c}. Then the indexes 0,1,2 would correspond to a, b, and c respectively.

The reduction function ensures that when the index produced, will always be within the appropriate range, which is [0,2] in this case, regardless of what the input hash is, by taking mod of the plaintext space, hence the name "reduction function".

This means that there is a space advantage in storing the indexes instead of storing either the hashes or plaintexts. The advantage of storing indexes over storing hashes is that the range of indexes stored will always be smaller than the range of hashes, which means there is more potential to save space should the file be compressed.

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Similarly, it is more space conservative to store an index than to store the plaintext which would mean we would have to encode each individual ASCII character, which is inefficient since only a small portion of characters are used in a typical rainbow table.

## Storing the Chain

The advantage of Rainbow tables, is that we do not need to retain every link in the chain in order to store all the information represented by the Rainbow Table. In fact, we only need to store the first and the last links in each chain to use the information effectively.

**index**->plaintext->hash->index->plaintext->hash->...->hash->**index**

All but the start and end index of the chain is discarded, and the indexes are written to file in binary, with the end indexes being sorted in ascending order, to allow for a binary search during decryption.

In a .RT file, both the raw values of the start and end index are stored as 64-bit integers. Below is an example of a few rainbow chains in little endian.The start indexes are in purple and the end indexes are in blue.

```
000000000h: D2 0B 0E 00 00 00 00 00 91 06 00 00 00 00 00 00
000000010h: FA 2D 0E 00 00 00 00 00 9D 06 00 00 00 00 00 00
000000020h: CE 06 09 00 00 00 00 00 AD 06 00 00 00 00 00 00
000000030h: AB 03 04 00 00 00 00 00 AE 06 00 00 00 00 00 00
```

There are various ways to store and compress rainbow tables. Please see Compatible File Formats for more information on this.

The parameters of the rainbow table file (including the hash algorithm, the number of chains, the chain length etc.) are kept in the filename. Please refer to .RT Naming Convention for details on how the parameters are stored.

5.23.3.1.4 Character Sets

Rainbow tables contain passwords belonging to a specific character set.

OSForensics uses a default list of character set definitions for both Rainbow Table generation and decryption.

**Specifying a Character Set**

Users can specify a list of character set definitions by adding a configuration file named charset.txt to the RainbowTables folder in the OSForensics working path folder.

Inside charset.txt, there should be one character set definition per line. each character set definition should specify a character set name, and the contents of the character set inside square brackets assigned with an '='. For example:

```
alpha                       = [ABCDEFGHIJKLMNOPQRSTUVWXYZ]
alpha-space                 = [ABCDEFGHIJKLMNOPQRSTUVWXYZ ]
alpha-numeric               = [ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789]
alpha-numeric-space         = [ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789 ]
alpha-numeric-symbol14      = [ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789!@#$%^&*()-_+=]
```

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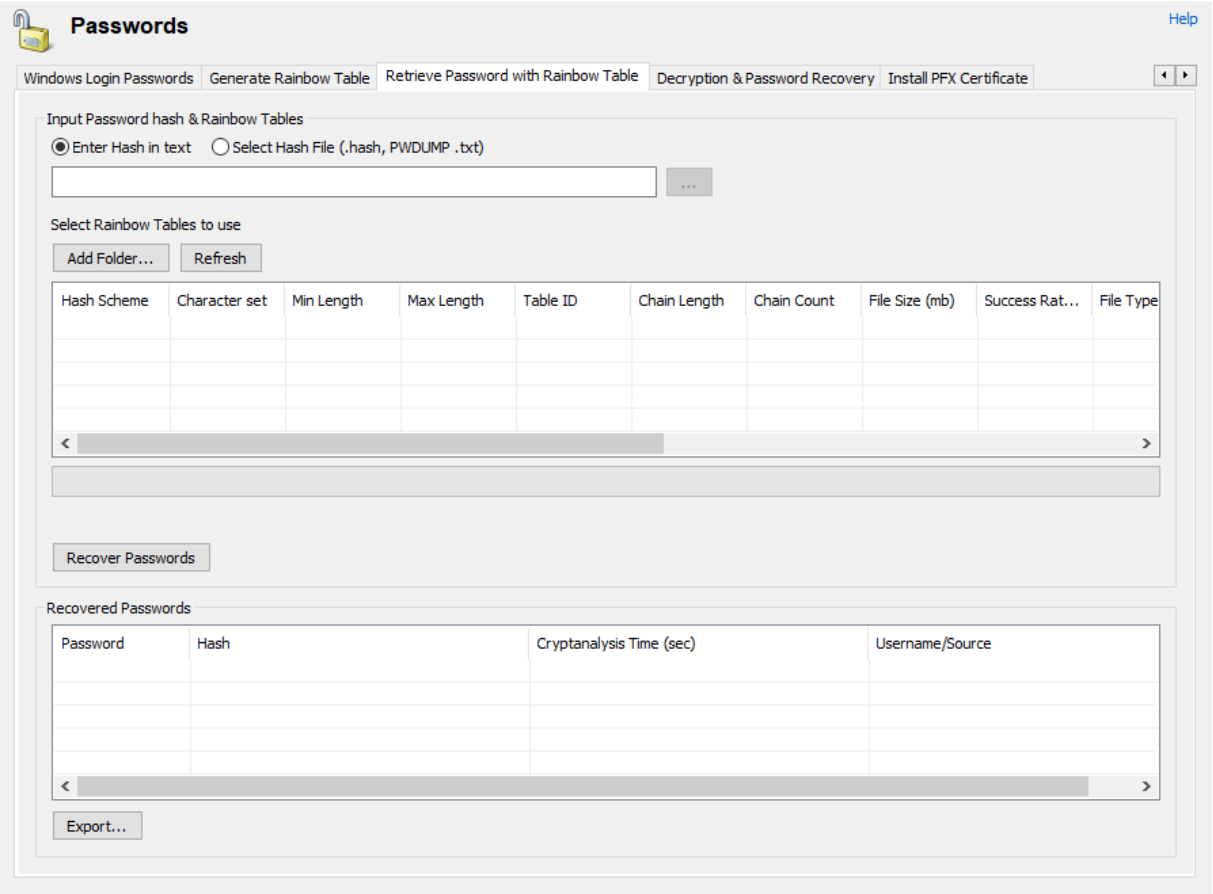
### 5.23.4 Recovering Passwords Using Rainbow Tables

Passwords may be recovered using a suitable Rainbow Table and the hash of that password. Using this feature, a hash can be searched for within the Rainbow Table, and may successfully return the password in plain text.




Before using this feature, either generate an appropriate Rainbow Table (see Generating Rainbow Tables), or use an existing rainbow table. Rainbow Tables are available for download from various sources online. We offer a small collection of sample Rainbow Tables that you can download for free from our website, but these are meant primarily as examples. For more serious investigations, you can purchase a hard drive containing a large collection of Rainbow Tables from our website: http://osforensics.com/rainbowtables_hashsets.html.

Rainbow tables in .RT, .RTC and .RTI format can be placed in the "RainbowTables" folder within the **OSForensics** working folder (Try *C:\ProgramData\PassMark\OSForensics\RainbowTables*). By default, tables generated by OSForensics will be saved in this folder. The refresh button can be clicked to update the list of Rainbow Tables if a table has just been created or moved to the RainbowTables folder in the same run of **OSForensics**. Tables in a folder can by added by clicking "Add Folder..." and then selecting a directory. Tables added in RTI format will be shown as a single entry in the Select Rainbow Tables list box.

Note that for **OSForensics** to recognize a Rainbow Table file it's file name must follow the File Naming Convention used by **OSForensics**.

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Select the Rainbow Tables to search through by ticking the check box corresponding to that Rainbow Table. Note that selecting more rainbow tables can make the decryption process slower.

To recover a password using a Raw Hash, simply input the hash under the Raw Hash Field.

**Decrypting a Hash List file**

A hash list file contains one hash per line. To create a hash file, simply open a text file and write one hash per line. For example:

```
B03A340319A12864F8EBBD4FA5799B41
D253B68A594383481C80397D52C3A13E
3E8061DD481552E23DCC193F0B8C47E7
```

Then save the file with a .hash extension.

To recover passwords from a Hash List file, select the "Select File" radio button and then click the "..." button and select the file.

To start the decryption process click "Recover Password/s". To stop the process click "Cancel".

**Decrypting a PWDUMP file**

Either use an existing PWDUMP text file, or extract the LM hashes from a machine, use the Windows Login Passwords function in OSForensics, then save the extracted data to file.

"Select File" radio button and then click the "..." button and select the file.

To start the decryption process click "Recover Password/s". To stop the process click "Cancel".

### 5.23.5 File Decryption & Password Recovery

This function will allow you to decrypt files that use **40-bit encryption** or run a **dictionary based attack** on files using different encryption methods to recover the password. Files can be added to the work queue to be processed sequentially.

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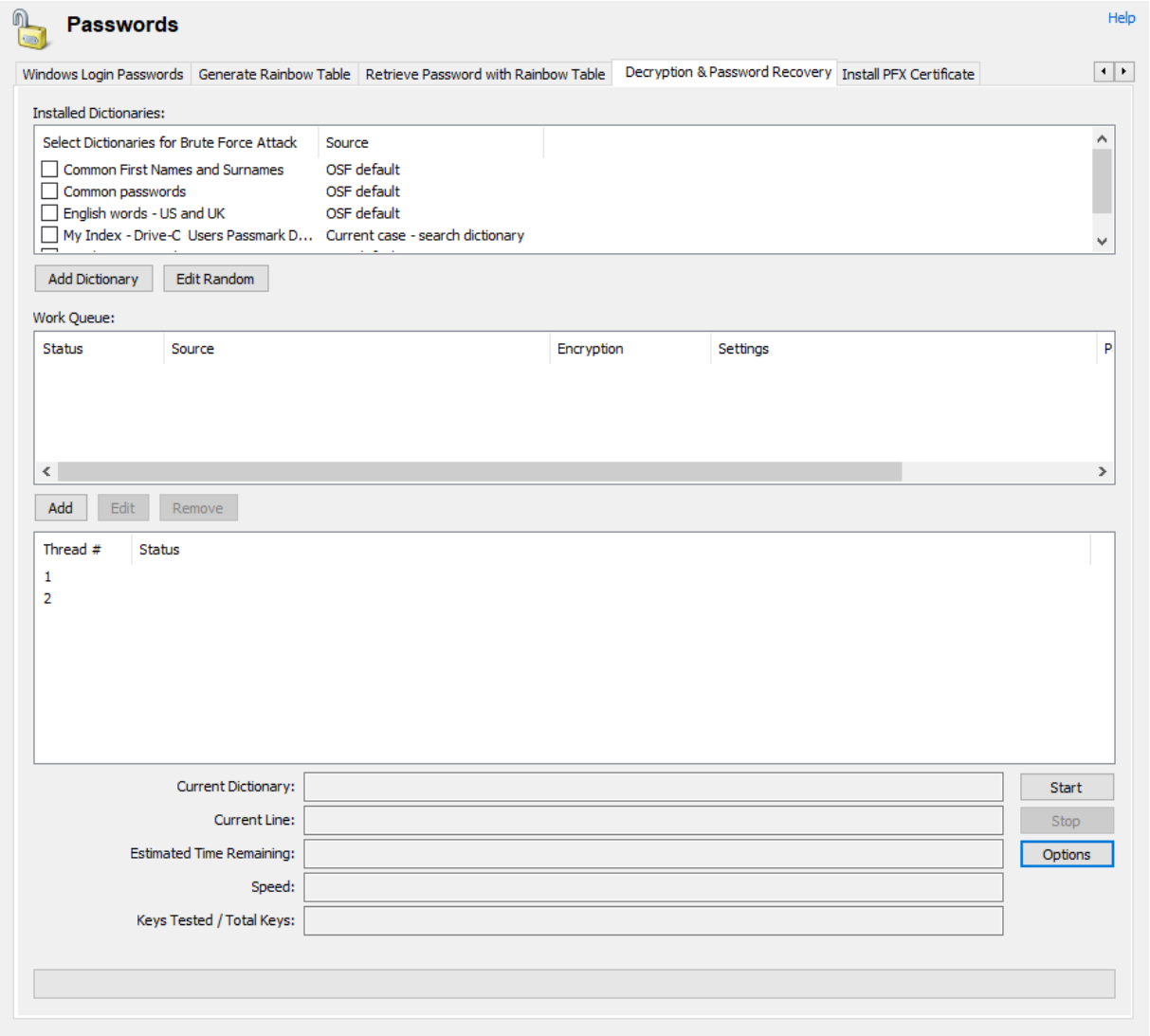


## Installed Dictionaries

Shows the dictionaries that are installed. If you have created a search index for the current case the dictionaries from these indexes will shown here. OSForensics provides several different dictionary options:

- **Common Passwords:** This is a list of common used passwords created from statistical lists and published passwords lists.
- **English words - US and UK:** an English based dictionary. This dictionary contains 79165 lowercase words in a combination of UK and US spelling. After testing all lowercase words the first letter of each is capitalized and tested again. This word list was combined from several Ispell word lists.
- **Names:** This is a list of common first names and surnames from the US, UK, Europe and Asia (550 in total). Each name is tried separately and then as various combinations which results in approximately 165,000 combinations.
- **Random:** Depending on the settings chosen (see the **Edit Random** section) will generate different random passwords based on a combination of letters, symbols and numbers.

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The rest of the entries in the list are the available search indexes from the currently select case. See the "Adding Dictionaries" section for information on how to add your own custom dictionaries.

**Select Dictionaries for Brute Force Attack:** Clicking on the check-box for a dictionary here will select it for use with a brute force attack.

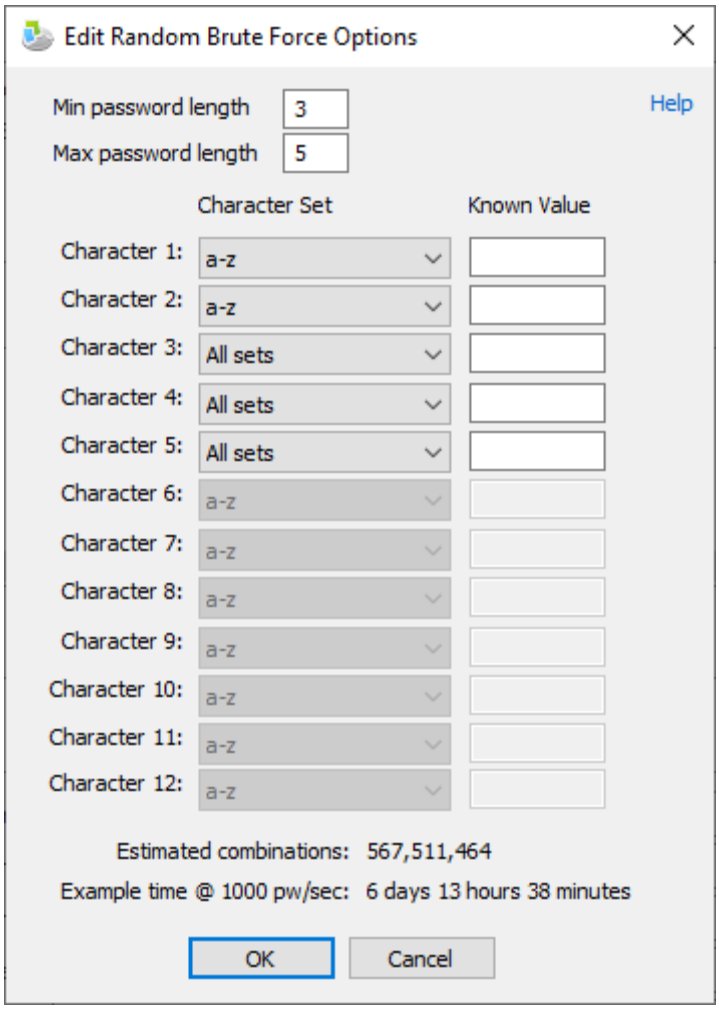
**Add Dictionary**

Using this button will prompt for a text file containing a list of words (one per line) to be used as a dictionary. This file will be copied to the directory:

ProgramData\Passmark\OSForensics\PasswordRecovery\Dictionaries

A simple definition file (.def) used by the decryption software will be created when adding dictionary text file. See the "Adding Dictionaries" section for more information about how the dictionaries work and more advanced ways of using them.

**Edit Random**




This feature is applied when only the **Random Passwords** dictionary is selected.

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Min: Minimum password length

Max: Maximum password length

Character 1 - 12: For each character in the password the type of character it can be needs to be selected from the options;

- All sets - all available characters
- a-z - all lower case letters from a - z
- A-Z - all uppercase letters from A - Z
- a-z & A-Z - both cases of letters a - z
- 0-9 - all numbers from 0 - 9
- a-z & A-Z & 0-9 - all alphanumeric characters
- ~@#$% - special characters {}:"<>?[];\',./~!@#$^&*()_+`-=|
- Known - a known character, must be typed in the edit box for the character

The number of combinations will be displayed when the password parameters are changed. The image above will test password from 3 - 6 characters long, starting with "A", followed by up to 3 letters, symbols or numbers, and ending in up to 2 digits (For example, "A##", "A12z", "Abc#12" would all be generated by this option) and results in over 92 million passwords.

# Work Queue

Files added to the work queue and their selected settings will be shown here. During the cracking process, the **status** of each file will be updated to show if a process was successful or unsuccessful. For brute-force password recovery the password will be shown upon success.

**Remove**

Remove a file from the work queue.

**Edit**

Edit the recovery settings for a file added to the queue.

**Add File**

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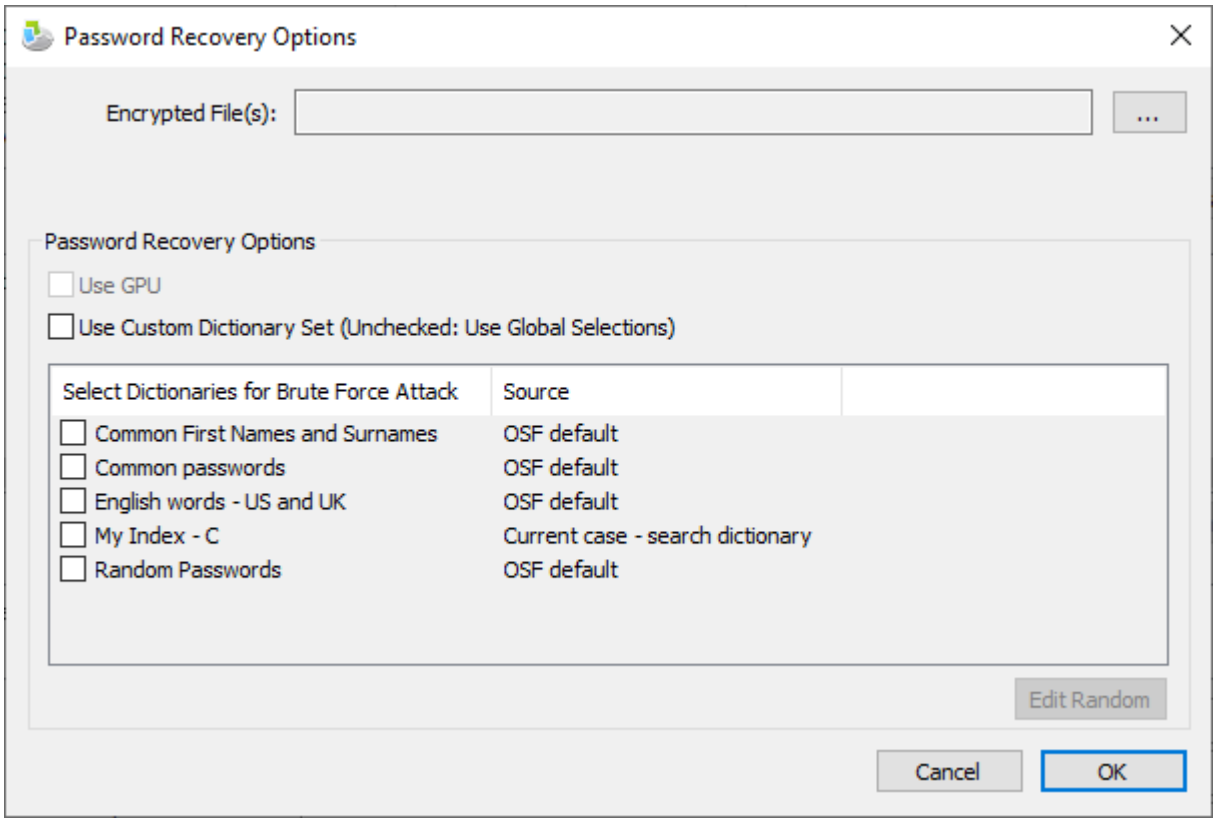
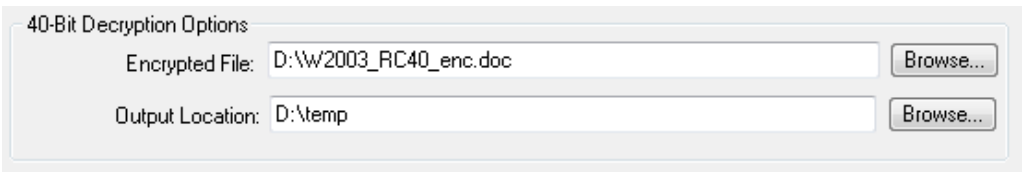



### Encrypted File

File name of an encrypted file. The following file types are supported:

- Microsoft Office (doc, docx, docm, xls, xlsx, xlsb, ppt, pps, pptx, pptm, ppsm, pdf)
- Archives (zip, rar, 7z)
- OpenOffice (LibreOffice only) (odt, ott, odp, odf)

**40-Bit Decryption:**
OSForensics will display different options depending on the encryption method detected. When OSForensics detects **40-Bit Encryption** the following options will be displayed. 40-bit decryption is guaranteed but can take several days, for example when running on an Intel® Core™2 Duo E8400 it can take approximately 1.8 days to test all the available 40bit keys.




**Encrypted File**: File name of a file encrypted using 40 bit keys. This can be a PDF, XLS or DOC file. To check if a PDF file uses 40 bit encryption you can open it in the OSForensics file and hex viewer, go to the meta data tab and check the "Encryption" entry, a version of 1.x can indicate 40bit encryption. For XLS and DOC files those encrypted in 97 and 2000 editions should use 40bit encryption.

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**Output Location**: Working directory for temporary files and where decrypted output file is created.

### Password Recovery Options

These options are only enabled and available for selection for password recovery: (Note: Although they are displayed the dictionaries are not used when 40bit encryption is detected.)

#### Use GPU

This option only applies for when the above method (Random Passwords) is being used. Checking this box will enable use of the GPU for faster cracking. Note that not all GPUs are supported. When decrypting a 40 bit file, use of GPU to decrypt is not currently supported.

#### Use Custom Dictionary Set

If unchecked, the brute force attack will use the dictionaries selected on the main cracking module. Select this option if use different dictionaries than the global selection is required. Clicking on the check-box for a dictionary here will select it for use with a brute force attack for this file only.

## Running & Recovery Status

### Options

- Number of Local CPU Clients: The number of local clients that will be started. The default (recommended) will be the same as the number of logical cores that is seen by Windows OS. Decryption is compute intensive and can slow down other computer operations when running, if not desirable, lower the number of clients to run.
- Allow Remote Clients (**Pro Only**): This will allow users to run additional clients on a separate machine to aid in password decryption. You will need to make sure the server application (ext_run_server.exe) is allowed through the firewall and may need to forward ports on your network to allow outside traffic to communicate with the server. See Using external PWRecClientMgr application for setup. The TOTAL number of clients supported either local or remote is 1000 clients.

### Start/Stop

When the "Start" button is clicked, decryption will begin in which a number of threads will be launched, one for each available logical processor. For example on a machine with a quad core CPU 4 threads will be launched. If "Use GPU" is checked, a single GPU thread, plus a CPU thread equal to the number of available logical processors minus one, will be launched.

Clicking the "Stop Decrypting" button will stop the threads. When decrypting a 40 bit file, if the temporary files have not been deleted when "Start Decryption" is clicked again decryption will resume from where it was last stopped.

#### 5.23.5.1 Adding Dictionaries

The dictionary and password definition file used by OSForensics are located in the "OSForensics\PasswordRecovery\Dictionaries" folder (in Win7/Vista this will default to C:\ProgramData\PassMark\OSForensics\PasswordRecovery\Dictionaries) .To add your own custom

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dictionary you will need to create 2 files in this directory - a dictionary file (.dic) and a definition file (.def).

The dictionary file is a list of words, one word per line, for example;

aardvark
aardvark's
aardvarks
aaron

The definition file is a structured file that is used to set which dictionary is being used and can be used to make alterations to the words in the dictionary.
To define a dictionary use $w = "dictionary name", and $u = "dictionary name" if you want to combine two dictionaries.

"##" is a required section of the file and marks the end of the dictionary setup. After this you can use $w and $u to refer to a word from each dictionary, and use modifiers to alter the words.

The simplest definition file, that loads a dictionary and then tests each word in the dictionary is;

```
$w = "dictionary_name.dic"
##
$w
```

To use a modifier to capitalize the first letter of each word in the dictionary, effectively doubling the number of passwords, you can use "$w.u(1)".

```
$w = "english-us-uk-combined.dic"
##
$w
$w.u(1)
```

The other modifiers available are;

.u (upper) to upper-case
.l (lower) to lower-case
.t (truncate) to truncate up to the given length
.j (joke) to upper-case some letters
.r (reverse) to reverse the word
.s(shrink) to shrink the word
.d (duplicate) to duplicate the word

Each modifier will accept a parameter in after itself,

.u or .u(0) to upper-case the whole word (PASSWORD)
.u(1), .u(2) to upper-case only the first (the second) letter (Password, pAssword)
.u(-), .u(-1) to upper-case the last (the next to last) letter (passworD, passwoRd)
.t(-1) to truncate the last letter in the word (passwor)
.j(0) or .j to upper-case odd letters (PaSsWoRd)
.j(1) to upper-case even letters (pAsSwOrD)
.j(2) to upper-case vowels (pAsswOrd)
.j(3) to upper-case consonants (PaSSWoRD)
.r(0) or .r to reverse the word (drowssap)
.s(0) or .s to reduce the word by discarding vowels unless the first one is a vowel (password -> psswrd, offset -> offst)

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.d(0) or .d to duplicate the word (passwordpassword)
.d(1) to add reversed word (passworddrowssap)

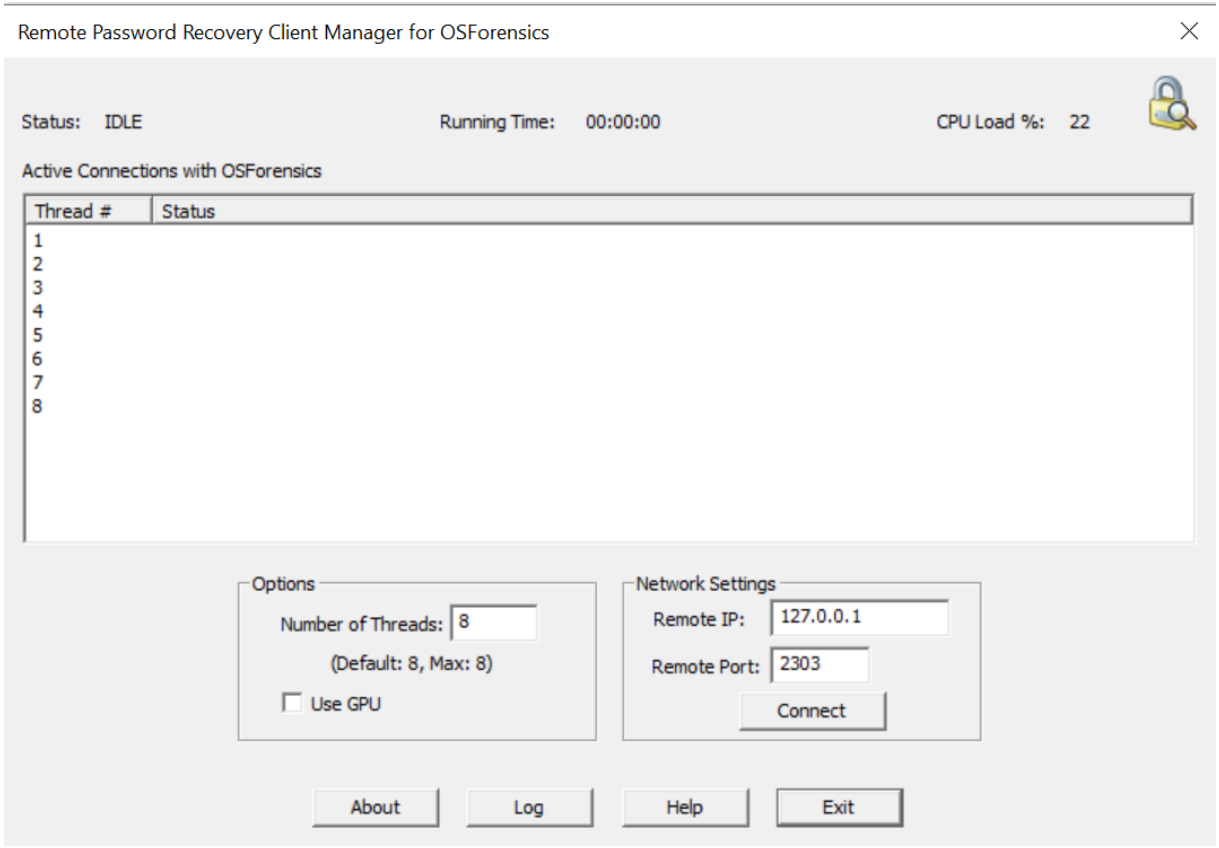
### 5.23.5.2 Remote Decryption Clients

Using external application, Password Recovery Client Manager (PWRecClientMgr.exe), users can run additional clients on a separate/multiple machines to aid in password decryption. The PWRecClientMgr is a standalone application that is started on a remote machine.

The “PWRecClientMgr.exe” application and other required files (see below) are included in the OSForensics ProgramData directory and should be copied to the remote PC’s and run from these systems. For example the files should be copied from the OSForensics ProgramData directory on the main PC, C:\ProgramData\Passmark\OSForensics\PasswordRecovery, to each remote PC to same directory, e.g. C:\PWRecClientMgr. The application can be started by double clicking on the PWRecClientMgr.exe file.

Required Files/Directories:
- ext_cpu_client.exe
- ext_gpu_client.exe
- PWRecClientMgr.exe
- pthreadVC2.dll
- GPUSupport.dll
- test_dll (Entire directory)

## Using the external Password Recovery Client Manager



### Number of Threads

The number of local CPU clients that will be started. The default will be the same as the number of logical cores that is seen by Windows OS. Decryption is compute intensive and can slow down other computer operations when running, if not desirable, lower the number of clients to run.

### Use GPU

Checking this box will enable use of the GPU for faster cracking. Not all GPUs are supported. The number of GPUs supported will be shown. If enabled, the total of clients started will be the number of GPU clients supported plus the number of threads specified, e.g. Number of Threads is 8, Use GPU is checked with two GPUs supported, then 10 clients (8 CPU threads + 2 GPU threads) will be started.

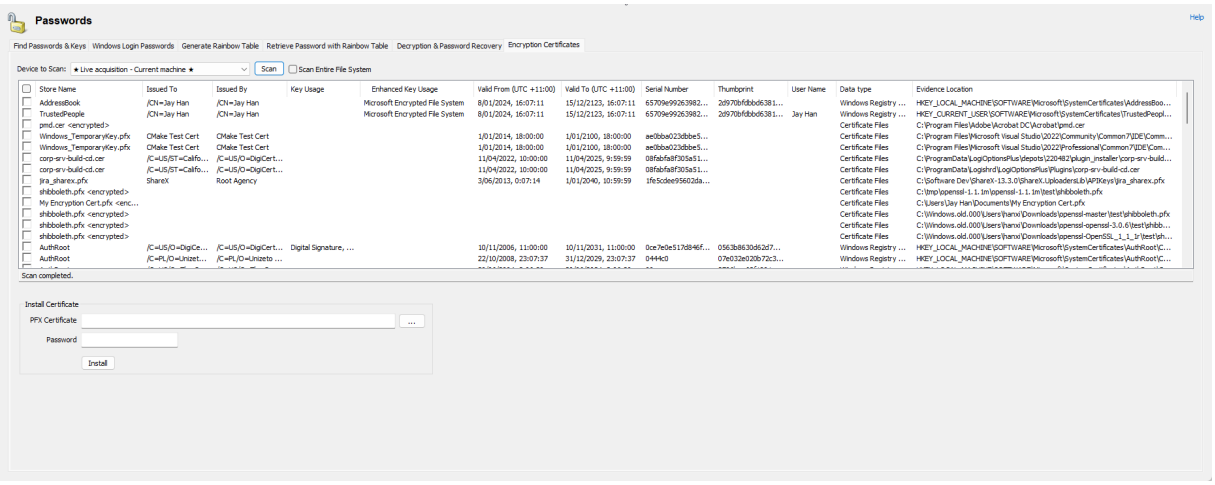
### Remote IP/Remote Port

The IP address and Port of the machine running OSForensics with an active password decryption queue.

### Connect

Clicking Connect will signal the application to start the clients and connect to the computer running OSForensics.

## 5.23.6 Encryption Certificates




This module attempts to retrieve certificates from Windows Registry and search for certificate files stored on the drives.

It scans the following Registry locations:

- HKEY_CURRENT_USER\SOFTWARE\Microsoft\SystemCertificates

- HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\SystemCertificates

**Scan Entire File System:**
If checked it will perform a full drive scan to search for certificate files. This only works with live acquisition of the current machine.
If unchecked it will scan the selected drive only for the certificate files with extensions *.pfx and *.cer.

**Install Certificate:**
This feature allows to install a PFX backup or recovery certificate that is associated with Windows EFS encrypted files from a disk image or another system.
Use the browse button to select the PFX certificate. Enter the password (if required) for the certificate and then click the install button.

To view, export, import, and delete installed certificates use the Windows built-in "Certificate Manager" tool.
Select Run from the Windows Start menu, and then enter certmgr.msc to view certificates for the current user.
EFS certificates are located in the Personal -> Certificates folder.

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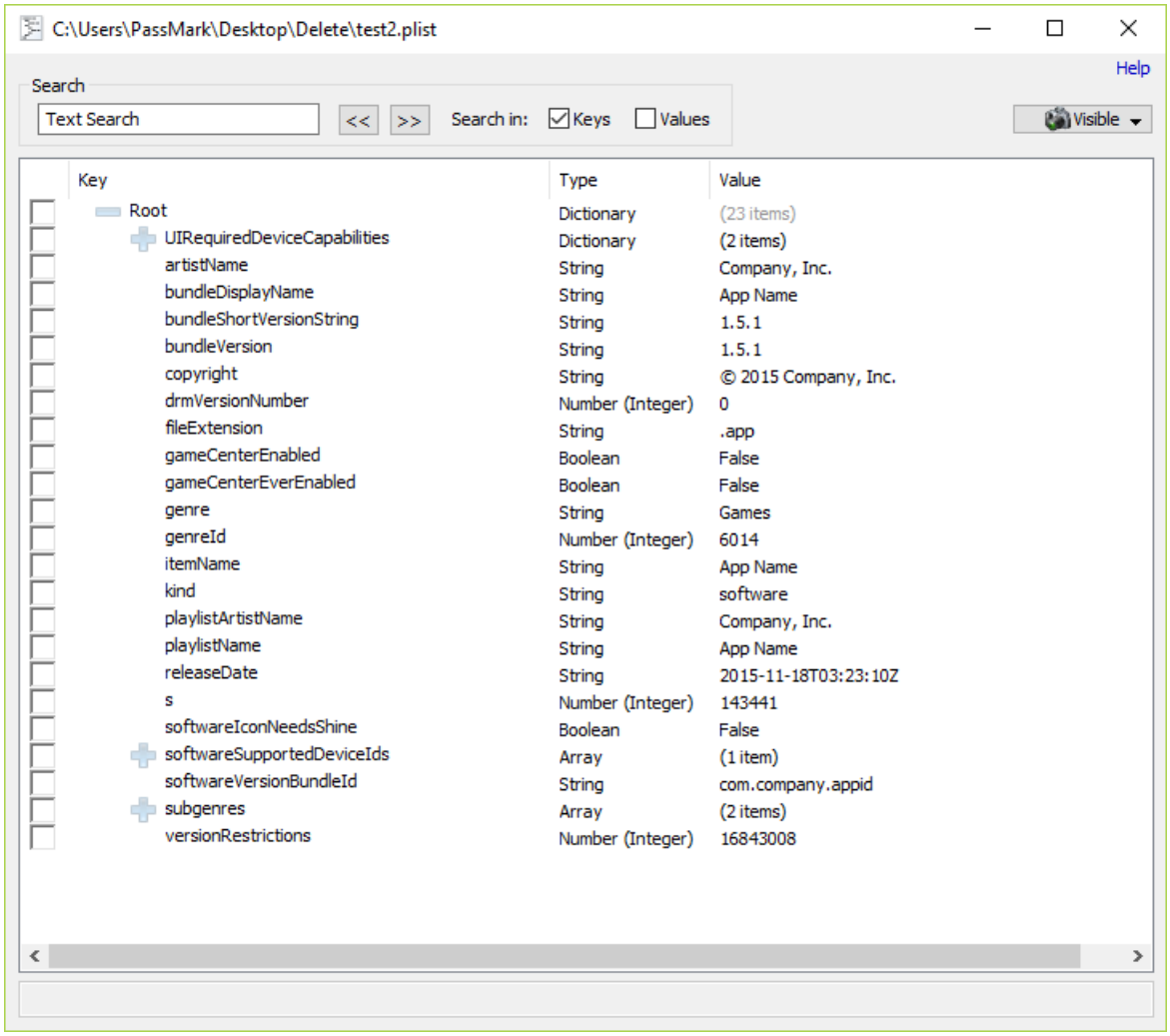
## 5.24 Plist Viewer

View the contents of Plist (property list) files which are commonly used by OSX and iOS to store settings and properties. Plist files typically have the extension of ".plist". The Plist Viewer within OSForensics is able to display both binaries and XML formatted plist files.




## Understanding the Plist Viewer

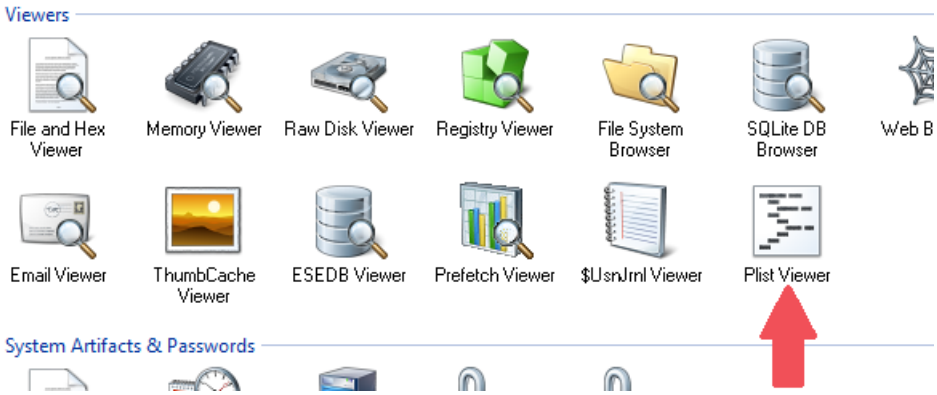
The table below summarizes the main components of the Plist Viewer

| Component | Description |
|---|---|
| Window Title | Displays the current file opened in the Plist Viewer. |
| Search | Controls to allow you to search the current Plist file. |
| Screen Capture | Screen Capture controls. |

| | |
|---|---|
| Records List | Displays a list of records contained in the Plist file. |
| Status Bar | Displays the path information on the current item selected. |

## Opening the Plist Viewer

The Plist Viewer can be accessed via the "Plist Viewer" icon in the "Viewers" group under the Start tab.




Once opened, a file selection dialog will allow you to select a file from devices added to case or on the current system itself.

When attempting to open a file with a known Plist file extension using the internal viewer, the user may be given the option to open the file using the Plist Viewer instead.

## Usage

Once the plist file is opened, the list is populated with the contents contained in the property list. The four columns of the Plist viewer are Checkbox (for selecting/unselecting), Key, Key Type, and Key Value. The possible Key Types are: String, Boolean, Date, Data (binary), Number (Integer or Real) and collection types (Dictionary or Array). For collection types, it will display the number of immediate child items it contains for the Key Value. For a Key of Array type, the child items' keys does not actually have names, but are automatically given Key names of the format "Item n" where n is the index of the item starting with zero.

Items of type Data, the Key Value will only show the first 64 hex character representation of the binary data. A single left click will open a quick data preview window. A double left click will open the data in the internal viewer window.

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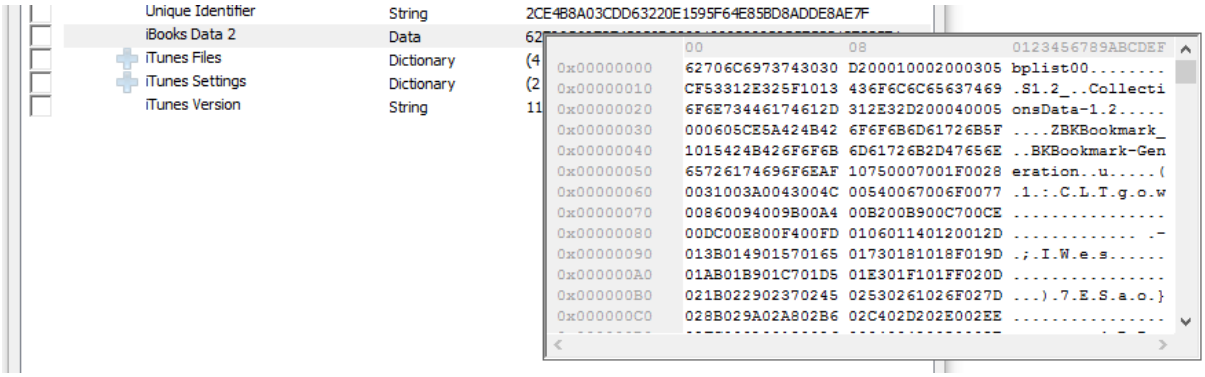
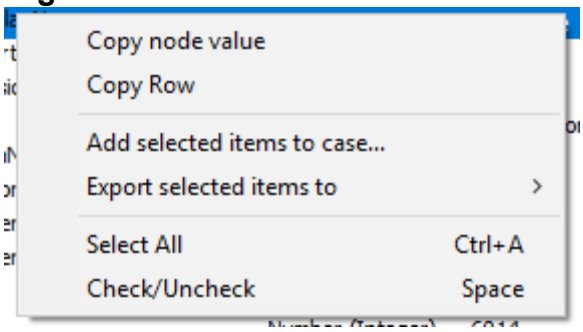



When checking an item with child elements, the children will also be selected. There are three visual states for the checkbox: checked, unchecked, mixed-checked. Selecting a child item will automatically check the parent item. Parent items with some children selected and unselected will display the mixed-checked checkbox.

## Search

To perform a simple text search of all records in the list, enter a search term and click 'Search'. The default will search the for matching text in the Keys. To search for text in the Values, check the Values checkbox. Note: Text search will not search elements with Data Key Types.

## Right-click Menu




**Copy node value**
Copy the Key's Value to the clipboard

**Copy Row**
Copies the entire row as text to the clipboard

**Add selected items to case...**
Adds the list of selected records to the case as a CSV file

**Export selected records to**

**txt**
Saves the list of selected records to a text file

**html**
Saves the list of selected records to an html file

**CSV**

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Saves the list of selected records to a CSV file

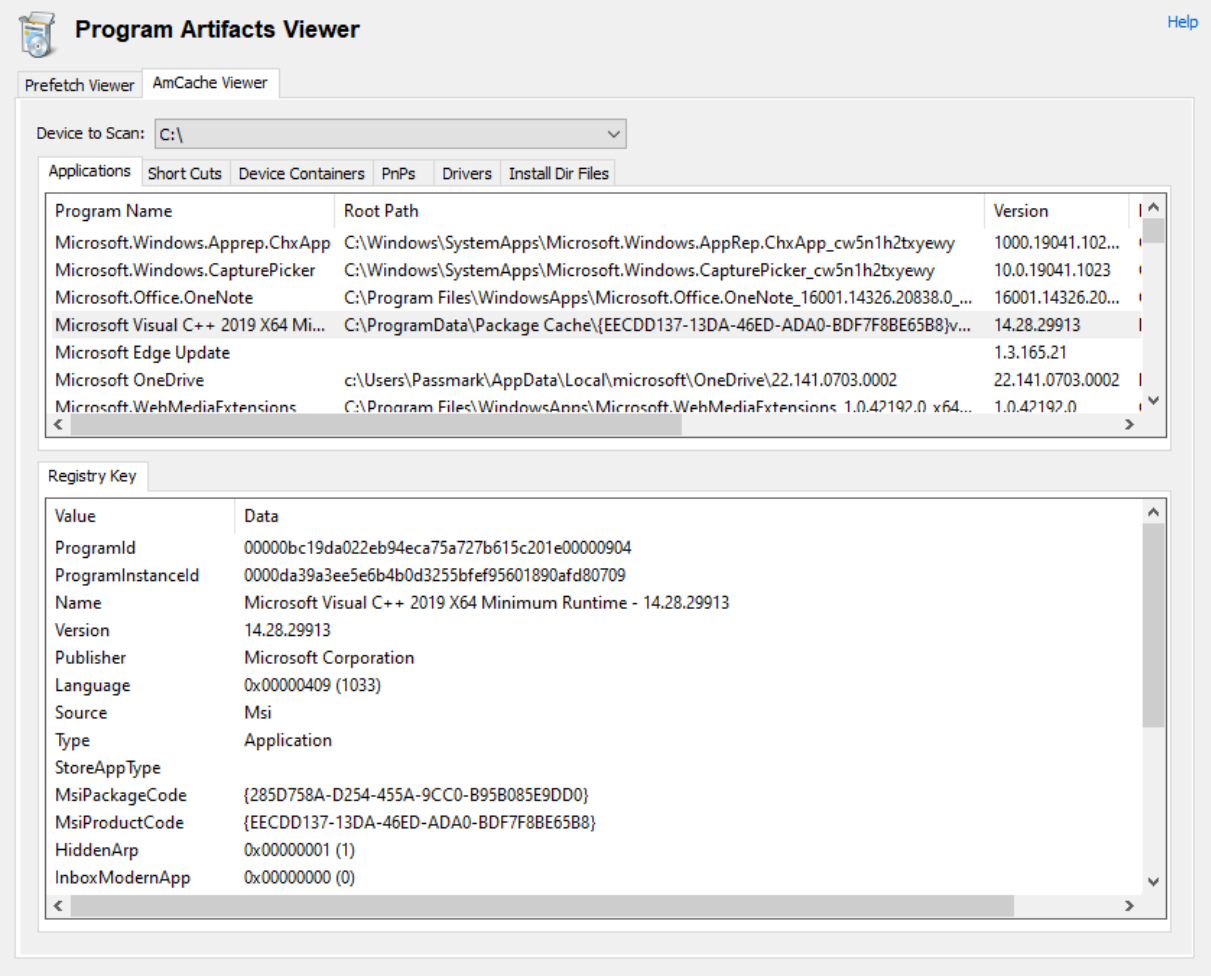
**XML Plist**
Saves the list of selected records to a XML Plist file

**Select All**
Select all of the records in the plist file

**Check/Uncheck**
Check/Uncheck all selected items.

## 5.25 Program Artifacts

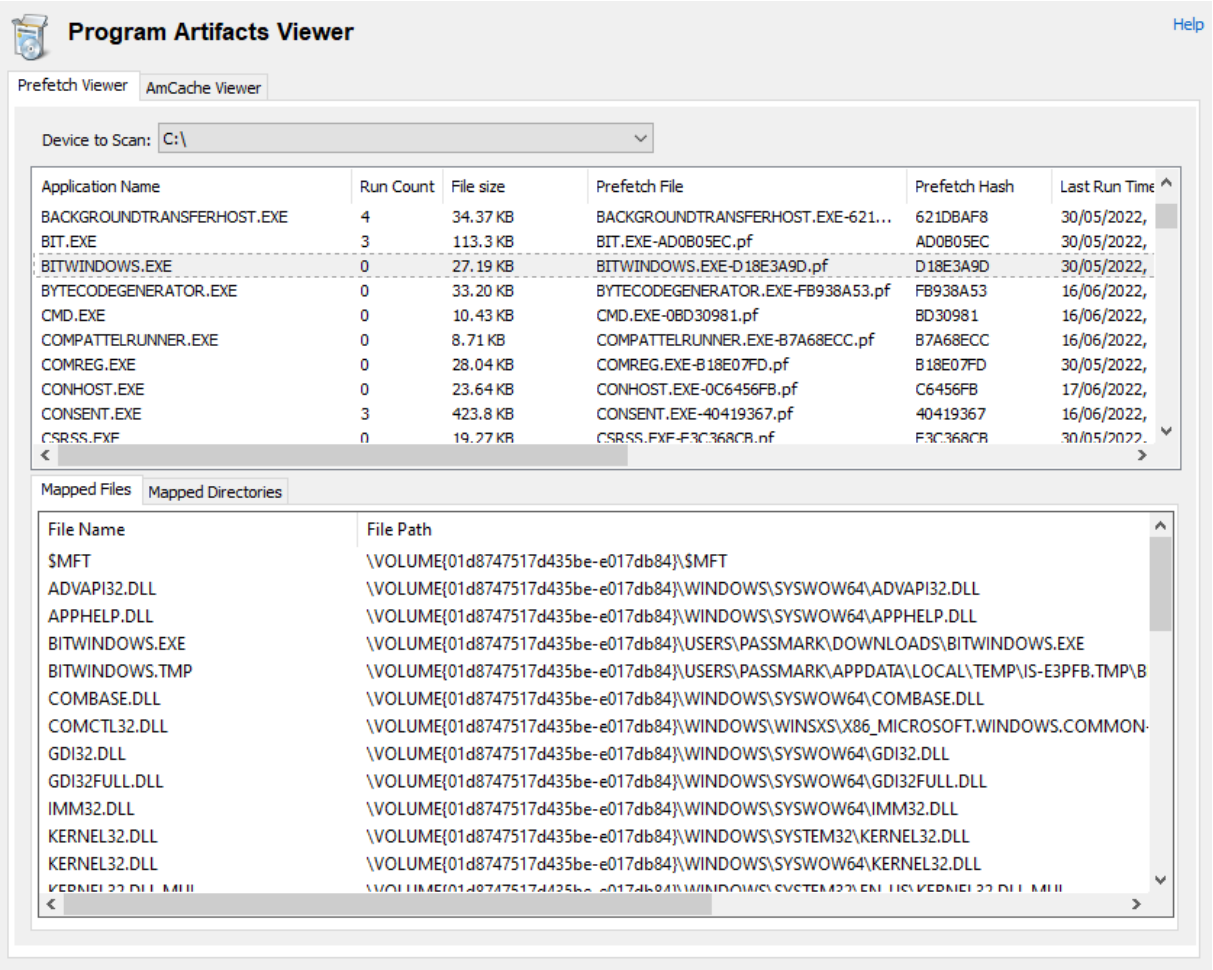
The Program Artifacts module collects program artifact traces left by applications. This includes artifacts from the Windows Prefetcher or AmCache hive which can be viewed in the Prefetch Viewer and AmCache Viewer.



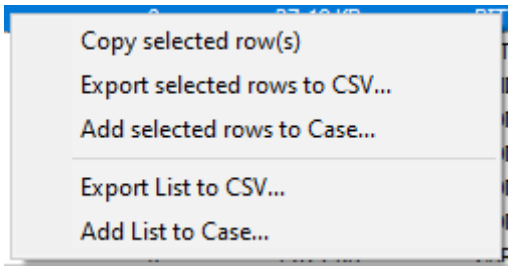

### 5.25.1 Prefetch Viewer

The Prefetch Viewer module allows the user to view the potentially valuable forensic information stored by the operating system's Prefetcher. The Prefetcher is a component that improves the performance of the system by pre-caching applications and its associated files into RAM, reducing disk access. To facilitate this, the Prefetcher collects application usage details such as the number of times the

application has been executed, the last run time, and any files that the application uses when it is running. Using this information, forensics investigators can uncover suspect's application usage patterns (eg. "Cleaner" software used recently) and files that have been opened (eg. documents).




Right-clicking an application entry brings up the following menu:




**Copy row(s)**
Copies the selected prefetch item details to clipboard

**Export selected rows to CSV...**
Export the selected prefetch items to a CSV file

**Add selected rows to Case...**

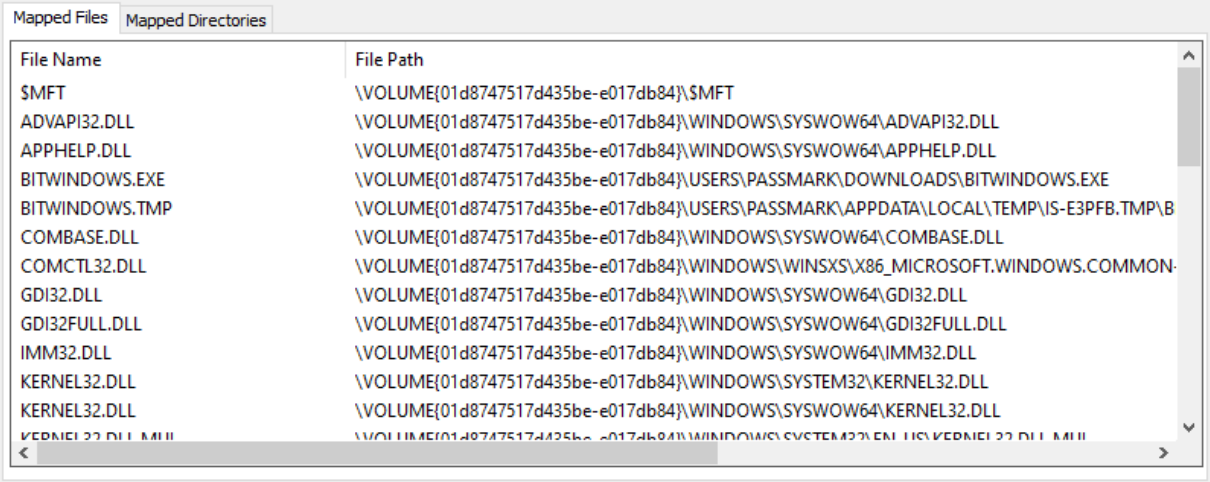
Add the selected prefetch items to case as a CSV file

**Export List to CSV...**
Export the list of prefetch items to a CSV file

**Add List to Case...**
Add the list of prefetch items to case as a CSV file

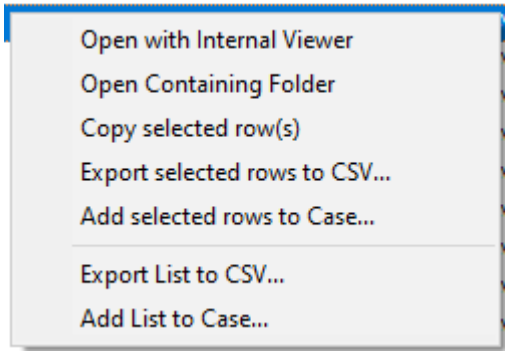
After selecting an application, the list of mapped files and directories used by the application is displayed.

## Mapped Files




This list view contains a ten-second snapshot of the list of files that were used by the application while executing. This includes the binary itself, associated system DLL files and files opened by the user using the application (such as document files for Microsoft Word). Forensically, this can reveal files of interest that were opened by the application (eg. document, image, e-mail files) and file paths that may have been hidden or no longer exists.

Right-clicking a file entry brings up the following menu:




**Open with Internal Viewer**
Attempts to locate the file on the drive and open it using the Internal Viewer.

**Open Containing Folder**
Attempts to open the parent folder of the selected file

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**Copy selected row(s)**
Copy selected file entry details to clipboard

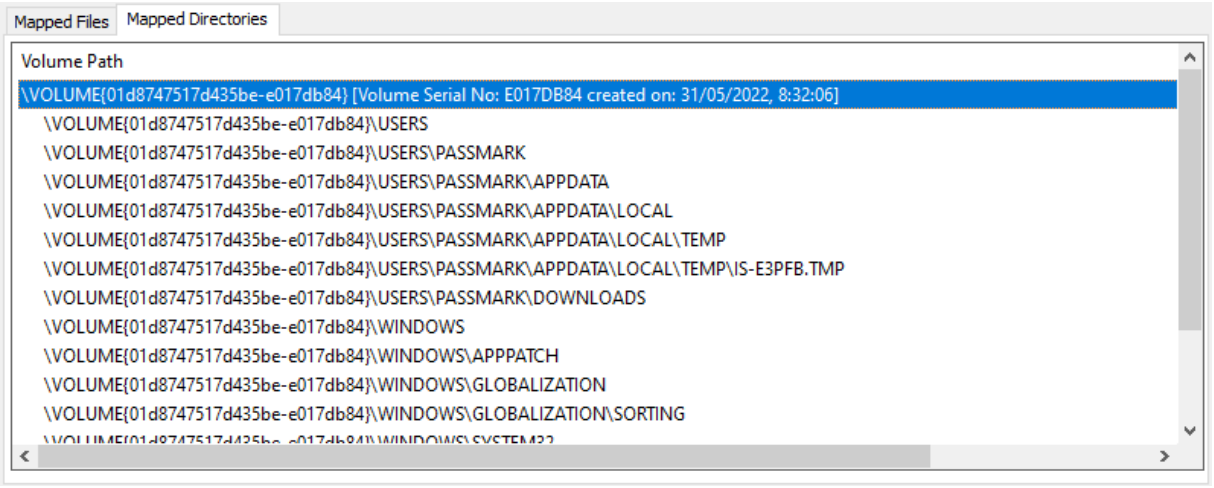
**Export selected rows to CSV...**
Export selected file entry details to a CSV file

**Add selected rows to case**
Add selected file entry details to case

**Export List to CSV...**
Export the list of mapped file entries to a CSV file

**Add List to Case...**
Add the list of mapped file entries to case as a CSV file

## Mapped Directories




This list view contains a list of directories and corresponding volumes that were accessed by the application while executing. This can be used to identify volumes and directory paths that may have been hidden or belonged to a removable disk.

### 5.25.2 AmCache Viewer

The AmCache Viewer module allows the user to view the potentially valuable forensic information stored in amcache registry hive. The AmCache hive stores metadata from programs installation and execution on Windows 7 and later machines. The AmCache hive keeps artifacts related to applications such as timestamps of creation and last modification of any application; name, description, publisher name and version of applications; execution file path, SHA-1 hash of executable files etc. These artifacts may persist even after the applications have been deleted from the system. The default location of the AmCache hive can be found on the system drive <system drive>:\Windows\appcompat\Programs\Amcache.hve.

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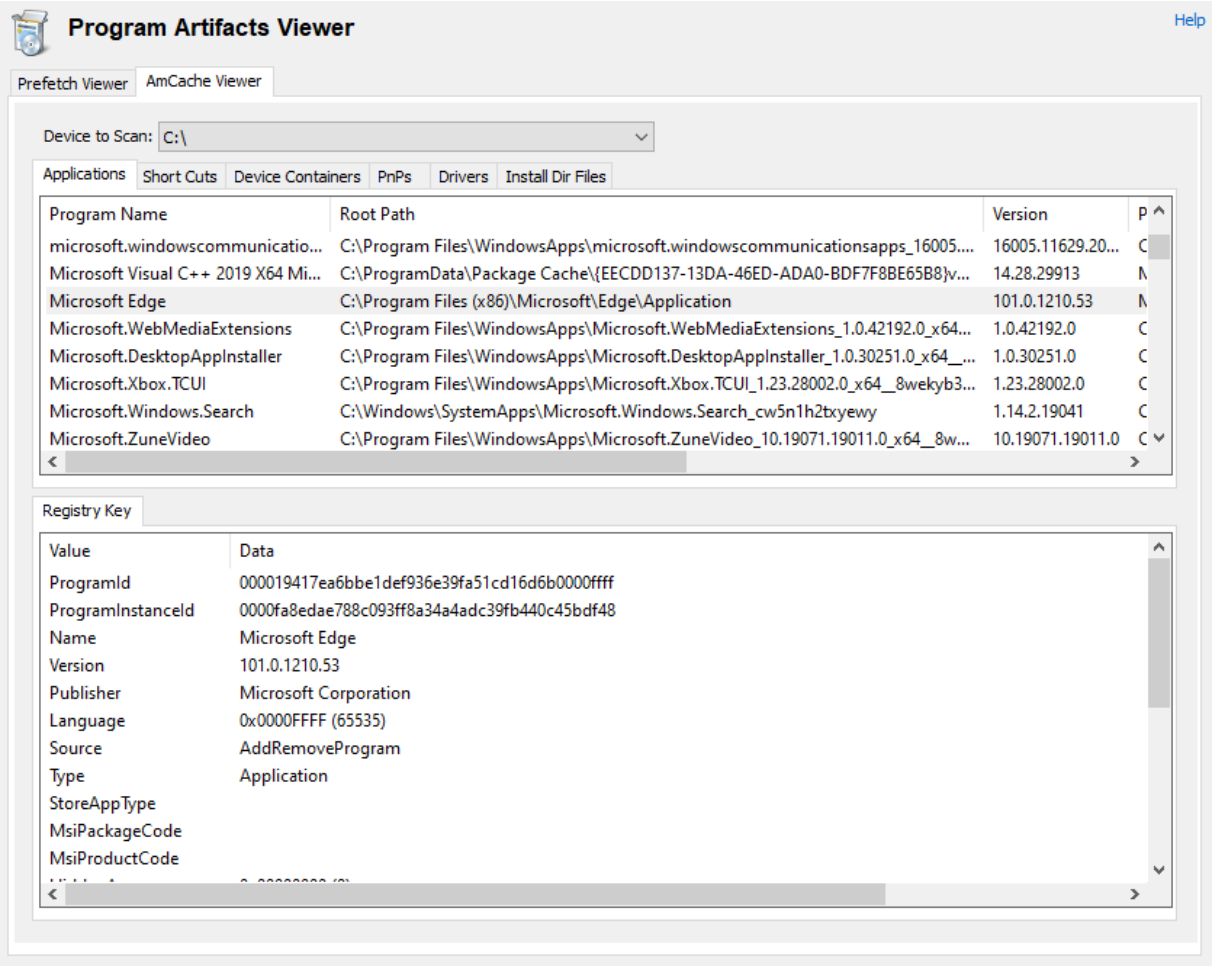


**Applications**
Contains metadata about EXEs if they are shimmed or executed and have a GUI or if they are in scanned directories. It also records metadata about EXE and SYS files if they were created on the system following a program installation.

**Shortcuts**
List LNK files found on the computer.

**Device Containers**
List of physical devices that were plugged into the system.

**PnPs**
List of plug and play devices that were plugged into the system.

**Drivers**
Contains metadata about driver files installed on the system.

**Install Dir Files**
List contains files found in the <system drive>:\Windows\appcompat\Programs\Install directory. This folder contains TXT files that records the installation of some programs, it is unknown why some programs do not have text file created. For setups that may install multiple EXE installed, a file is created for each whose filenames respectively starts with INSTALL_0000, INSTALL_0001 and

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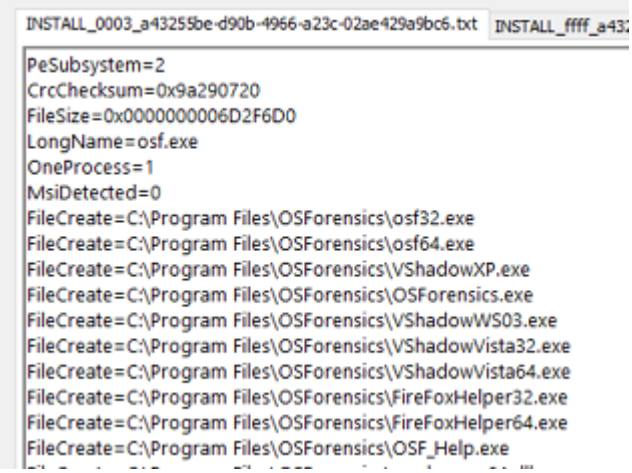
INSTALL_#### and one main file, INSTALL_ffff. These files list a wealth of information such as all the files that were installed along with the program. A tab is created for each #### file.




### Registry Key

After selecting an entry in the list (Applications, Device Containers, PnPs or Drivers), the corresponding registry key values are displayed.

## 5.26 Raw Disk Viewer

The Raw Disk Viewer module allows the user to analyze the raw sectors of all devices added to the case, along with all physical disks and partitions (including mounted images) attached to the system. This module provides the ability to perform a deeper inspection of a drive, looking beyond the data stored in the file system's files and directories. Performing this level of analysis may be required if information of interest is suspected to be hidden within the raw sectors of the drive, which are not normally accessible via normal operating system mechanisms (eg. free clusters, file slack space).

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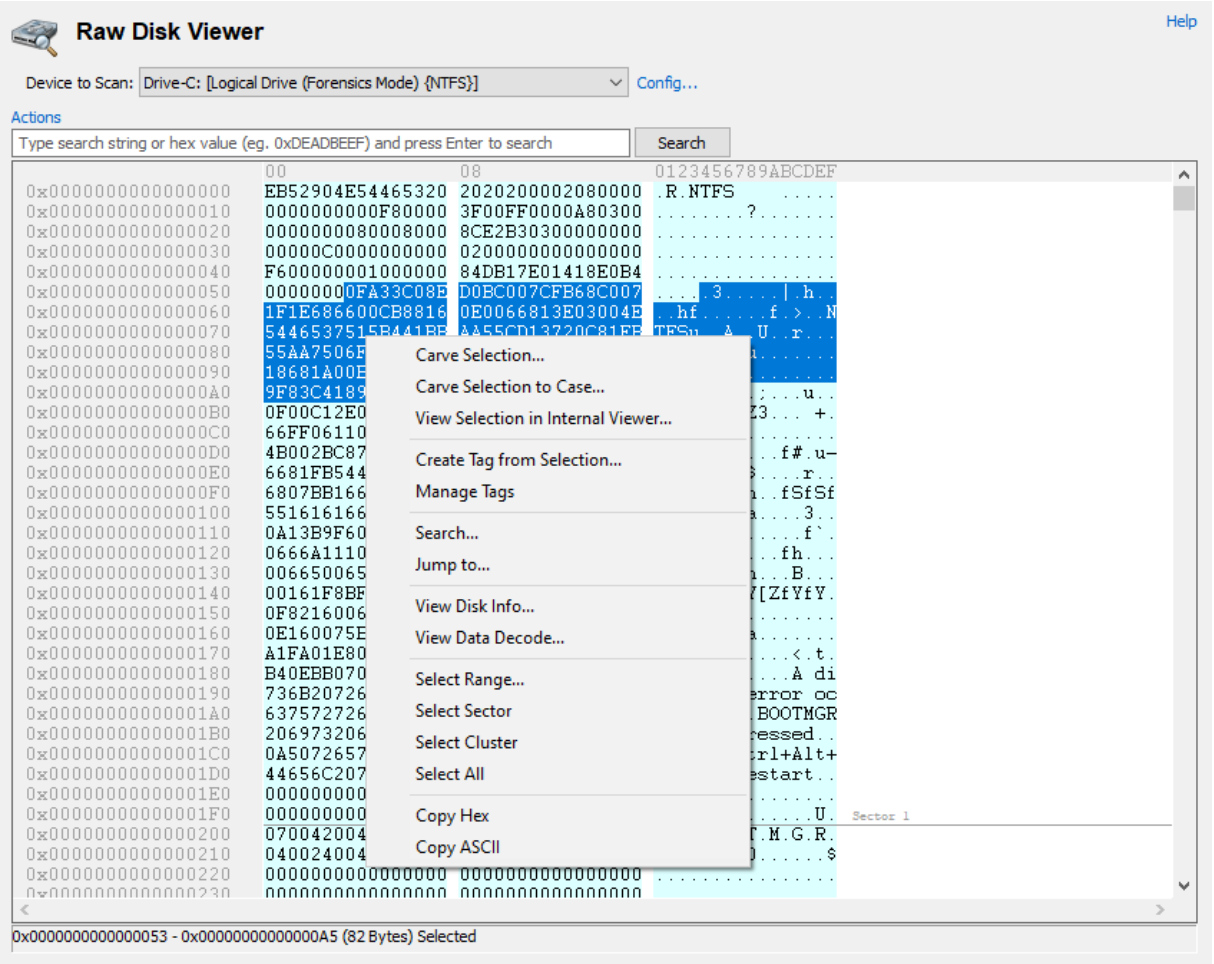


To view the raw sectors of a drive, the user selects the device from the *Device to scan* drop-down box.

Recovered partitions, if found on the disk, can also be selected.

**Config ...**
Opens a dialog to configure the display settings of the viewer.

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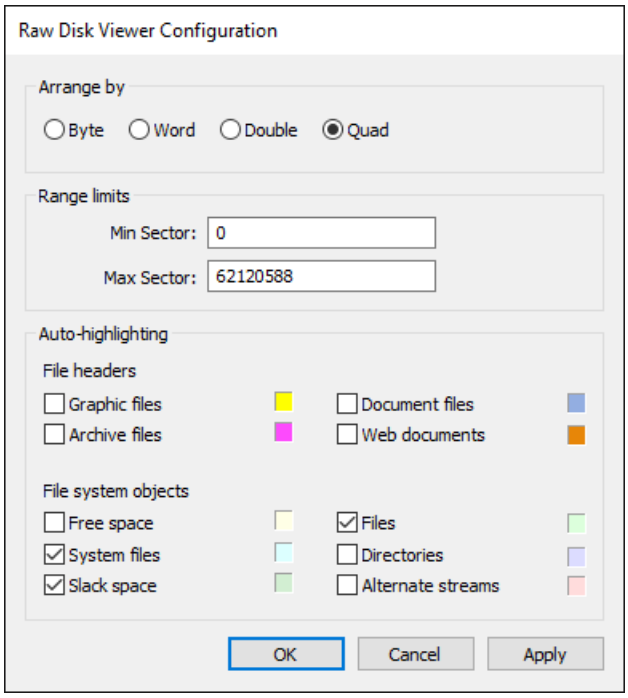


*Arrange by* - Adjust how bytes are grouped on the viewer (1, 2, 4, 8 bytes respectively) .

*Range limits* - Configure the minimum and maximum sectors viewable on the currently selected drive

*Auto-highlighting* - Toggle auto-highlighting of bytes of interest

File headers

- *Graphic files* - gif, jpg, png, bmp
- *Archive files* - zip
- *Document files* - pdf, rtf
- *Web documents* - html

File system objects

- *Free space* - unallocated clusters of a partition
- *System files* - bytes internal to the disk/partition for bookkeeping/management purposes (eg. MBR, MFT)
- *Slack space* - allocated space unused by the file or volume
- *Files* - bytes occupied by files
- *Directories* - bytes used by directories to store indexing information
- *Alternate streams* - bytes occupied by files' alternate stream(s) (NTFS only)

## Actions / Right Click Menu

**Carve selection...**
Save the selected bytes into a file. If no selection is made, the current cluster is saved.

**Carve selection to Case...**
Save the selected bytes into a file, then add to case.

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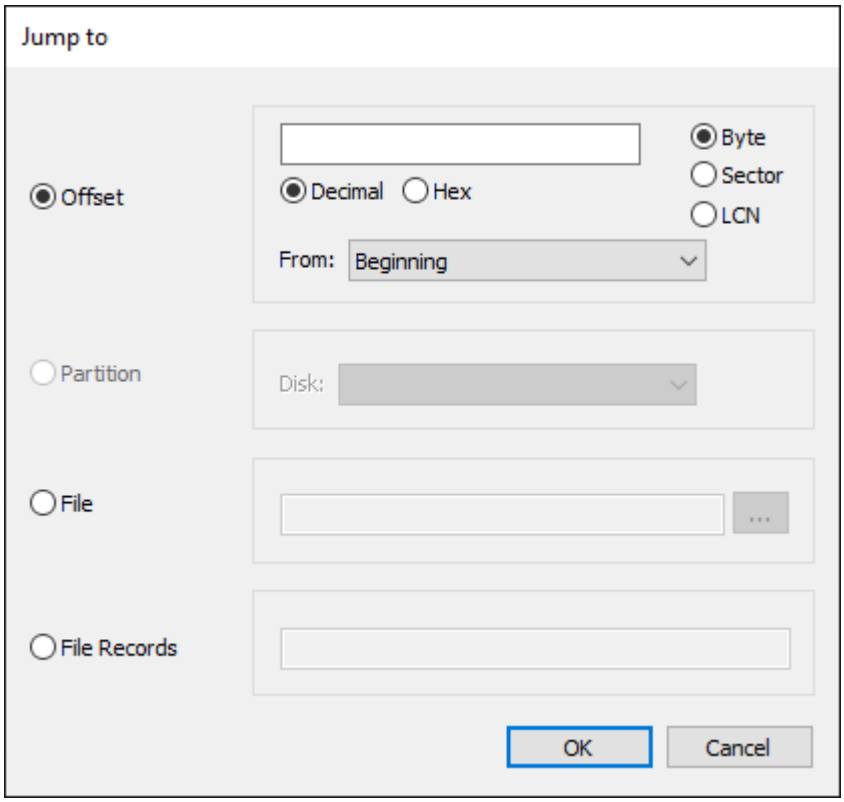
**View Selection with Internal Viewer...**
View the selected bytes in the OSForensics Viewer. If no selection is made, the current cluster is viewed.

**Create tag from selection...**
Create a tag with the selected offset range. If no selection is made, a dialog prompting the user to create a tag is displayed.

**Manage tags**
Opens the tag window for managing the tags on the drive

**Search...**
Opens a search window for locating hexadecimal/text patterns on the drive

**Jump to ...**
Allows the user to jump to a particular location on the raw disk.




*Offset* - Jump to the specified byte, sector, or logical cluster number (LCN) offset.

*From* - Specifies where (beginning of disk, current position or end of disk) to jump from when selecting byte or sector offset. A negative value (eg. -4096 in Dec., or -1F84 in Hex) will jump backwards from the current *Jump From* selection.

*Partition - (Physical disks only)* Jump to the start of the specified partition

*File - (Valid file systems only)* Jump to the starting cluster of the specified file on the partition

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*File Record - (Valid file systems only)* Jump to the file record structure of the specified file on the partition (eg. MFT record for NTFS file systems)

**View disk info...**
Opens a separate disk info window for displaying information about the current device.

**View data decode ...**
Opens a separate decode window for displaying information about the current position in the viewer

**Select Range...**
Prompts the user to enter a start and end offset to select

**Select Sector**
Select the sector that cursor is currently within

**Select Cluster**
Select the cluster that cursor is currently within

**Select All**
Select all bytes on the disk

**Copy Hex**
Copy the selected bytes as hex characters to clipboard

**Copy ASCII**
Copy the selected bytes as ASCII to clipboard

### 5.26.1 Search Window

The Raw Disk Viewer search window allows the user to perform searches on the raw sectors of the current device. The search is performed sequentially from the first viewable sector of the device, with the results being updated instantaneously in the search results table.

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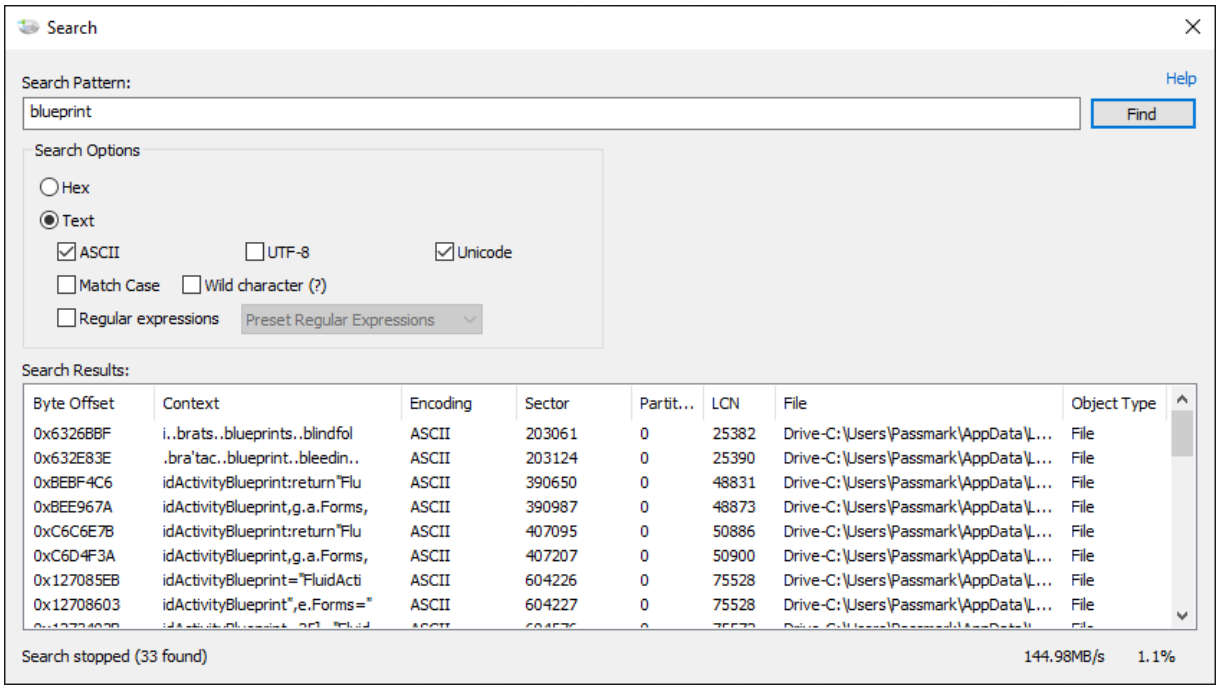


**Search pattern**
The search string to locate on the drive

**Search Options**

**Hex**
Search for a particular hex pattern on the drive. The hex pattern must be in byte increments, and must contain only valid hexadecimal characters (0-9, a-f).

**Text**
Search for the specified text string on the drive

*ASCII* - If checked, search for the text pattern in ASCII

*UTF-8* - If checked, search for the text pattern in UTF-8

*Unicode* - If checked, search for the text pattern in Unicode

*Match case* - If checked, the search will be case sensitive

*Wildcard character (?)* - If checked, a '?' in the search pattern will match any single character. Wildcards cannot be used in conjunction with regular expressions.

*Regular expressions* - If checked, the search pattern shall be interpreted as a regular expression. The regular expression pattern can be user-specified or selected from the list of preset expressions. Regular expressions cannot be used in conjunction with wildcards. See Regular Expressions for syntax information and examples.

**Search Results**
Displays (in real-time) all instances of the search pattern found on the drive. Double clicking on a result will highlight the matching bytes in the Raw Disk Viewer. The maximum length of matching strings is 256 characters.

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*Byte offset* - the starting byte offset

*Context* - the context (10 characters before and after) of where the pattern is found

*Encoding* - one of Hex, ASCII, UTF8, or Unicode

*Sector* - the starting logical sector

*Partition* - the partition number on the selected drive

*LCN* - the starting logical cluster number

*File* - (Partition only) the file which the found pattern belongs to. Note that this information is not available for physical disks.

*Object Type* - any particular property of the allocated space containing the found pattern. (Eg. File, directory, free space, slack space)

#### 5.26.1.1 Regular Expressions

The Raw Disk Viewer regular expression search is a powerful tool for identifying patterns that match a particular search specification on the raw device. The syntax and semantics of the search specifications are similar to Perl 5 (but not completely compatible), as the PCRE library is used for regular expression parsing and matching. The following is a quick reference of the supported regular expression syntax (as taken from the PCRE man pages), as well as several examples of forensics-related regular expressions.

*NOTE: The regular expression option for Precognitive Search in the Indexing module uses a different syntax.*

## Basic Syntax

```
QUOTING

        \x          where x is non-alphanumeric is a literal x
        \Q...\E     treat enclosed characters as literal

CHARACTERS

        \a          alarm, that is, the BEL character (hex 07)
        \cx         "control-x", where x is any ASCII character
        \e          escape (hex 1B)
        \f          formfeed (hex 0C)
        \n          newline (hex 0A)
        \r          carriage return (hex 0D)
        \t          tab (hex 09)
        \ddd        character with octal code ddd, or backreference
        \xhh        character with hex code hh
        \x{hhh..}   character with hex code hhh..


CHARACTER TYPES

        .           any character except newline
        \C          one byte, even in UTF-8 mode (best avoided)
        \d          a decimal digit
        \D          a character that is not a decimal digit
        \h          a horizontal whitespace character
        \H          a character that is not a horizontal whitespace character
        \N          a character that is not a newline
        \p{xx}      a character with the xx property
```

```
        \P{xx}      a character without the xx property
        \R          a newline sequence
        \s          a whitespace character
        \S          a character that is not a whitespace character
        \v          a vertical whitespace character
        \V          a character that is not a vertical whitespace character
        \w          a "word" character
        \W          a "non-word" character
        \X          an extended Unicode sequence


GENERAL CATEGORY PROPERTIES FOR \p and \P

        C           Other
        Cc          Control
        Cf          Format
        Cn          Unassigned
        Co          Private use
        Cs          Surrogate

        L           Letter
        Ll          Lower case letter
        Lm          Modifier letter
        Lo          Other letter
        Lt          Title case letter
        Lu          Upper case letter
        L&          Ll, Lu, or Lt

        M           Mark
        Mc          Spacing mark
        Me          Enclosing mark
        Mn          Non-spacing mark

        N           Number
        Nd          Decimal number
        Nl          Letter number
        No          Other number

        P           Punctuation
        Pc          Connector punctuation
        Pd          Dash punctuation
        Pe          Close punctuation
        Pf          Final punctuation
        Pi          Initial punctuation
        Po          Other punctuation
        Ps          Open punctuation

        S           Symbol
        Sc          Currency symbol
        Sk          Modifier symbol
        Sm          Mathematical symbol
        So          Other symbol

        Z           Separator
        Zl          Line separator
        Zp          Paragraph separator
        Zs          Space separator

        Xan         Alphanumeric: union of properties L and N
        Xps         POSIX space: property Z or tab, NL, VT, FF, CR
        Xsp         Perl space: property Z or tab, NL, FF, CR
        Xwd         Perl word: property Xan or underscore


CHARACTER CLASSES

        [...]       positive character class
```

```
        [^...]      negative character class
        [x-y]       range (can be used for hex characters)
        [[:xxx:]]   positive POSIX named set
        [[:^xxx:]]  negative POSIX named set

        alnum       alphanumeric
        alpha       alphabetic
        ascii       0-127
        blank       space or tab
        cntrl       control character
        digit       decimal digit
        graph       printing, excluding space
        lower       lower case letter
        print       printing, including space
        punct       printing, excluding alphanumeric
        space       whitespace
        upper       upper case letter
        word        same as \w
        xdigit      hexadecimal digit


QUANTIFIERS

        ?           0 or 1, greedy
        ?+          0 or 1, possessive
        ??          0 or 1, lazy
        *           0 or more, greedy
        *+          0 or more, possessive
        *?          0 or more, lazy
        +           1 or more, greedy
        ++          1 or more, possessive
        +?          1 or more, lazy
        {n}         exactly n
        {n,m}       at least n, no more than m, greedy
        {n,m}+      at least n, no more than m, possessive
        {n,m}?      at least n, no more than m, lazy
        {n,}        n or more, greedy
        {n,}+       n or more, possessive
        {n,}?       n or more, lazy


ANCHORS AND SIMPLE ASSERTIONS

        \b          word boundary
        \B          not a word boundary
        ^           start of subject
        \A          start of subject
        $           end of subject; also before newline at end of subject
        \Z          end of subject; also before newline at end of subject
        \z          end of subject
        \G          first matching position in subject


ALTERNATION

        expr|expr|expr...
```

# Forensics Regular Expression Examples

### URL

```
http\://[a-zA-Z0-9\-\.]+\.[a-zA-Z]{2,3}(/[a-zA-Z0-9_\-\.]*)*
```

Matches:

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- http://www.w3.org/2001/XMLSchema-instance
- http://crl.microsoft.com/pki/crl/products/WinPCA.crl
- http://ocsp.verisign.com

Non-matches
- ftp://intel.com
- http://www.microsoft/

### Email

```
[\w\.=-]+@[\w\.-]+\.[\w]{2,3}
```

Matches:
- user@domain.com
- user@domain.jp.org
- user@domain.au

Non-Matches:
- user
- user@
- @domain

### Credit Cards (AMEX, VISA, MasterCard)

```
((4\d{3})|(5[1-5]\d{2}))(-?|\040?)(\d{4}(-?|\040?)){3}|^(3[4,7]
\d{2})(-?|\040?)\d{6}(-?|\040?)\d{5}
```

Matches:
- 3728-026478-55578
- 4056 1038 2489 4098
- 5259489765789863

Non-Matches
- 3056-1478-9785-8698

### IP addresses

```
((0|1[0-9]{0,2}|2[0-9]{0,1}|2[0-4][0-9]|25[0-5]|[3-9][0-9]
{0,1})\.){3}(0|1[0-9]{0,2}|2[0-9]{0,1}|2[0-4][0-9]|25[0-5]|[3-9]
[0-9]{0,1})
```

Matches
- 10.0.1.1
- 192.196.1.119
- 255.255.255.255

Non-Matches
- 001.010.0.0
- 192.168.01.119
- 256.257.258.259

### US Phone numbers (Optional area code)

```
\(?[\d]{3}\)?[\s-]?[\d]{3}[\s-]?[\d]{4}
```

Matches

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- (610)5647894
- 415-983-1066
- 525 189 1658

Non-Matches
- (610)(415)9898
- 415-11-9898

**Zipcodes**

```
\d{5}(-\d{4})?
```

Matches
- 90654
- 00989
- 55145-1679

Non-Matches
- 90654-
- 55897-178
- 5987

**US dates (mm/dd/yyyy or m/d/yy or m.d.yyyy)**

```
([0]?[1-9]|[1][0-2])[./-]([0]?[1-9]|[1|2][0-9]|[3][0|1])[./-]
([0-9]{4}|[0-9]{2})
```

Matches
- 02.25.1980
- 12/30/2004
- 01/01/2011

Non-Matches
- 02--25--1980
- 12-55-2004
- 13/12/2011

### 5.26.2 Disk Info

The Raw Disk Viewer disk info window provides detailed information about the selected device.

## Main Window

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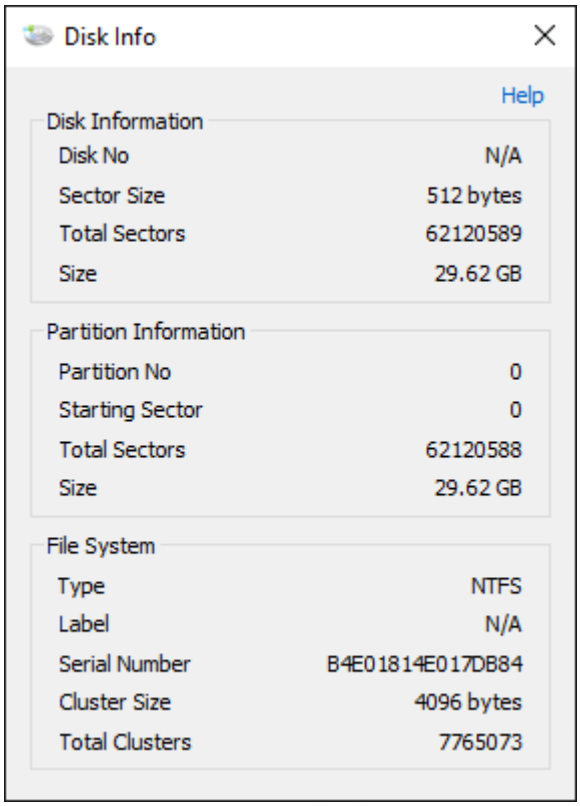


**Disk Information**

**Disk No**
The physical disk number of the selected device. Note that this information is not available for mounted images

**Sector Size**
The size of each sector in bytes

**Total Sectors**
The total number of sectors on the physical device. For mounted images, this is the number of sectors on the volume.

**Size**
The size of the physical device. For mounted images, this is the size of the volume.

**Partition Information**

**Partition No**
The partition number on the physical device. For mounted images, this is always zero.

**Starting Sector**
The physical sector offset of the partition on the physical device. For mounted images, this is always zero.

**Total Sectors**
The total number of sectors on the partition

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**Size**
The size of the partition.

**File System**

**Type**
The file system type (eg. NTFS, FAT32)

**Label**
The volume label

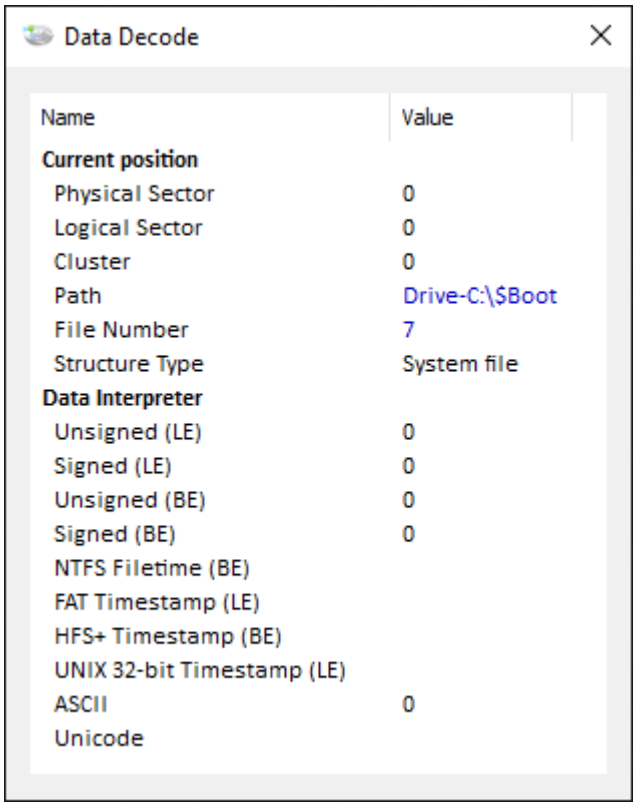
**Serial Number**
The volume serial number

**Cluster Size**
The size of each cluster in bytes

**Total Clusters**
The total number of clusters in the volume

### 5.26.3 Data Decode Window

The Raw Disk Viewer data decode window provides detailed information about the current offset on the selected device. This information is updated in real time as the cursor is moved in the raw disk viewer.



**Current Position**

**Physical Sector**
The sector number on the physical device of the current offset

**Logical Sector**
The sector number on the partition of the current offset

**Cluster**
The LCN (logical cluster number) on the volume of the current offset

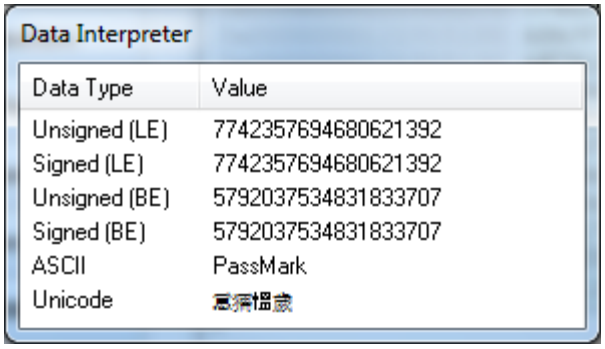
**File**
The file path of the file that owns the current cluster. Clicking on the file path will open Windows Explorer to the location of the file. Note that this information is not available if the selected drive is a physical disk.

**Object Type**
Any particular property of the allocated space that contains the current offset. (Eg. File, directory, free space, slack space)

## Data Interpreter

The Data Interpreter window parses the raw bytes into a human-readable format. Currently, there are two views available: *Data type interpreter* and *MBR interpreter*.

**Data Type Interpreter**
This is the default mode of the Data Interpreter window.




**Unsigned (LE)**
The selected bytes interpreted as unsigned, little-endian encoded. Note that this information is available only if 1-8 bytes are selected.

**Signed (LE)**
The selected bytes interpreted as signed, little-endian encoded. Note that this information is available only if 1-8 bytes are selected.

**Unsigned (BE)**
The selected bytes interpreted as unsigned, big-endian encoded. Note that this information is available only if 1-8 bytes are selected.

**Signed (BE)**

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The selected bytes interpreted as signed, big-endian encoded. Note that this information is available only if 1-8 bytes are selected.

**NTFS Filetime (BE)**
The selected bytes interpreted as a 64-bit, big-endian encoded NTFS file time. Note that this information is available only if exactly 8 bytes are selected.

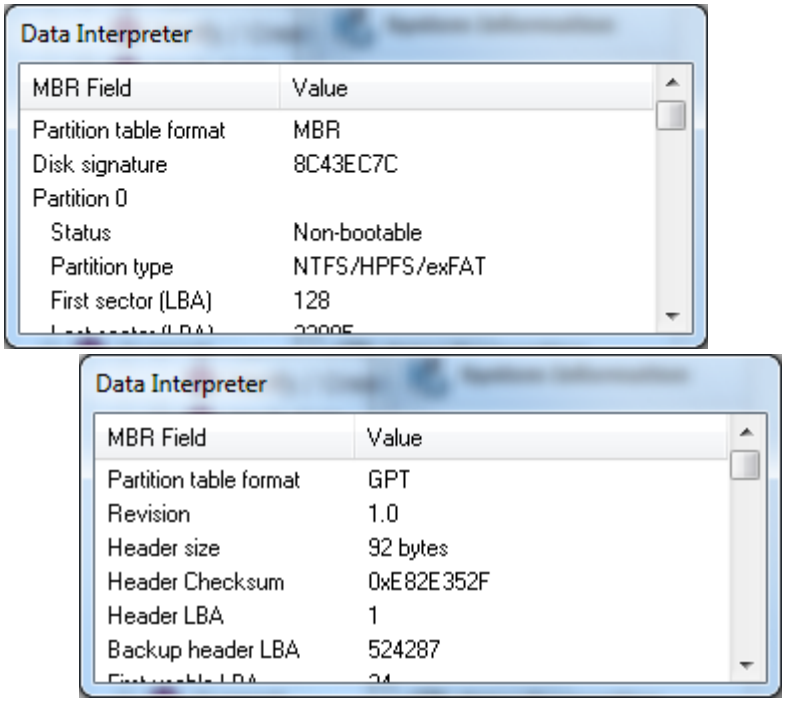
**FAT Timestamp (LE)**
The selected bytes interpreted as 32-bit, little-endian encoded FAT timestamp. Note that this information is available only if 4 bytes are selected.

**HFS+ Timestamp (BE)**
The selected bytes interpreted as 32-bit, big-endian encoded HFS+ timestamp. Note that this information is available only if 4 bytes are selected.

**ASCII**
The selected bytes interpreted as ASCII-encoded text. Note that this information is available only if 1-32 bytes are selected.

**Unicode**
The selected bytes interpreted as Unicode-encoded text. Note that this information is available only if 2-32 bytes are selected.

**Partition Table Interpreter**
This mode is automatically enabled when the current offset is within the first sector of a physical disk (ie. MBR). The partition table (MBR or GPT) is displayed in a human-readable format.




Double-clicking on a LBA field will jump to the appropriate offset in the disk viewer.

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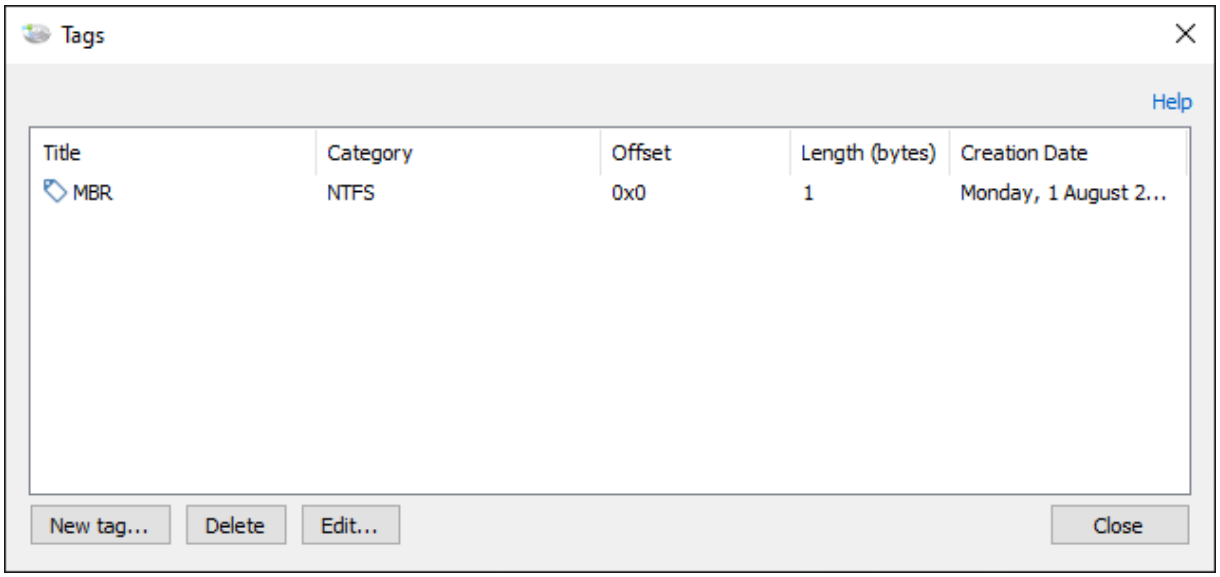
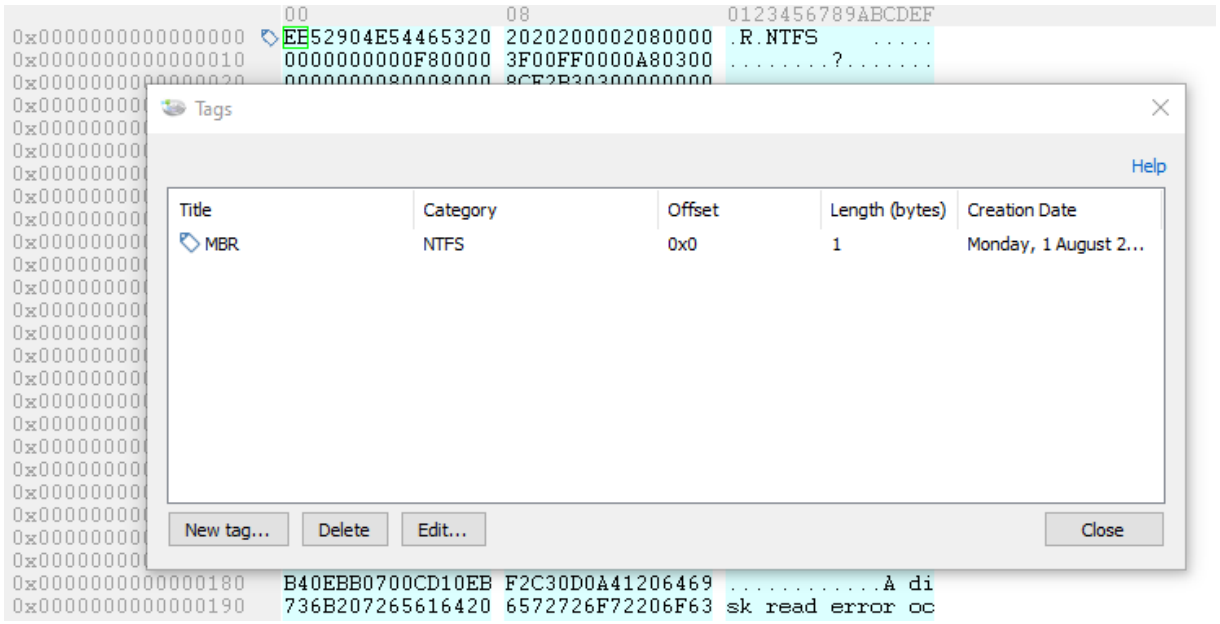
### 5.26.4 Tag Window

The Raw Disk Viewer tag window allows the user to manage the tagged offsets on the selected device.




The details of all tags visible on the raw disk viewer is displayed in the list.

Tags are useful for marking offset ranges of interest on the drive so that it is readily accessible at any time. tags are indicated by a tag icon, and square brackets to mark the beginning and end of the tag.




**New Tag**
Opens a dialog for specifying the properties of a new tag.

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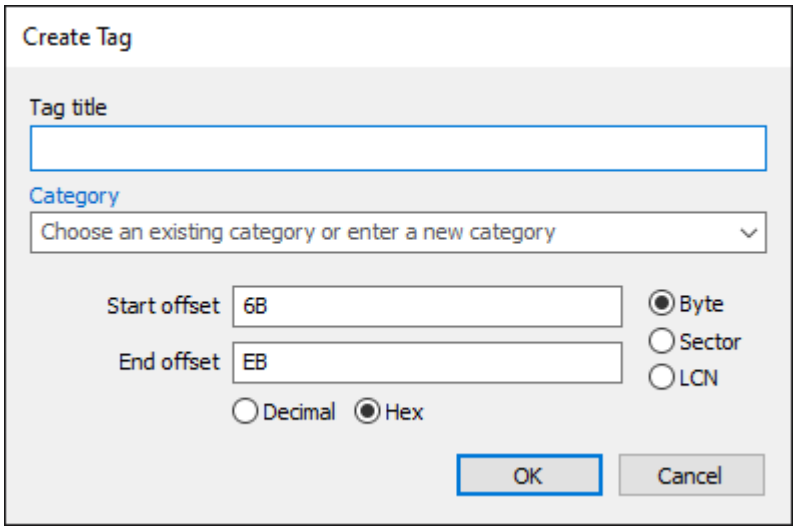


*Tag name* - The name of the tag

*Start offset* - The starting offset of the tag

*End offset* - The ending offset of the tag

**Delete**
Delete the selected tag.

**Edit ...**
Change an existing tag's name and/or type.

## 5.27 Registry Viewer

OSForensics includes a built in registry viewer to display the contents of registry hive files and has options to copy value names, data and to export registry keys and their sub keys to a text file.

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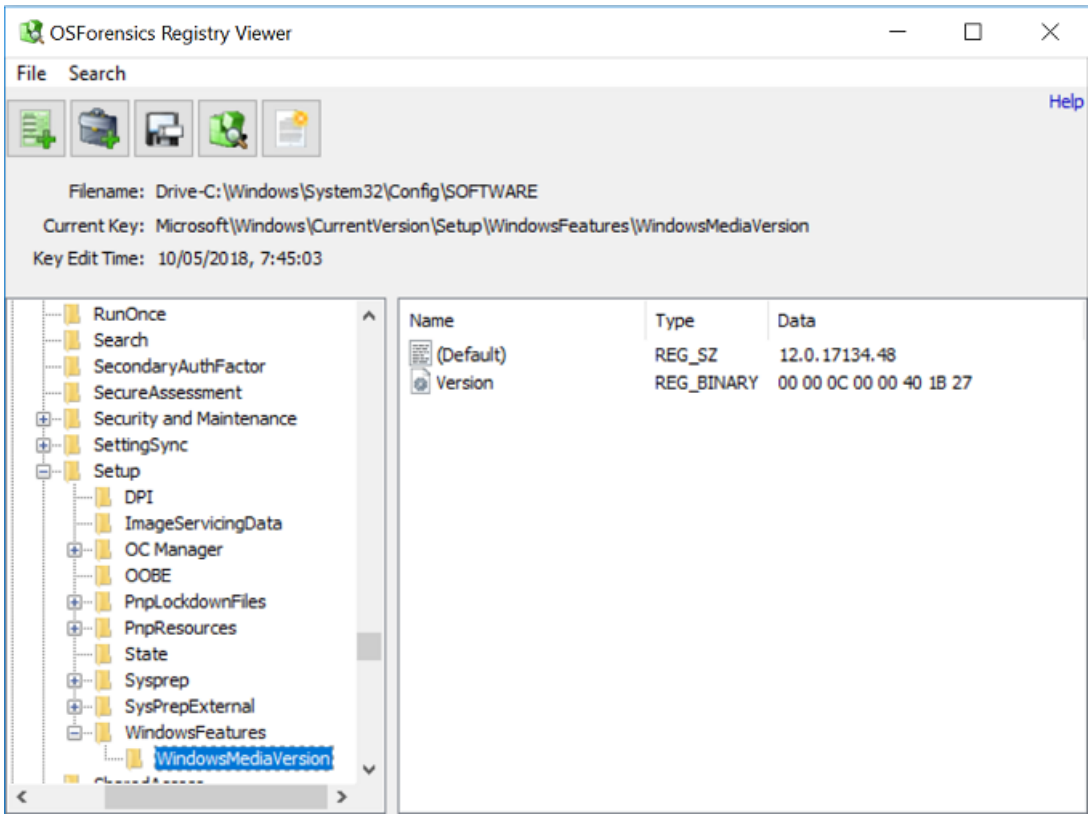
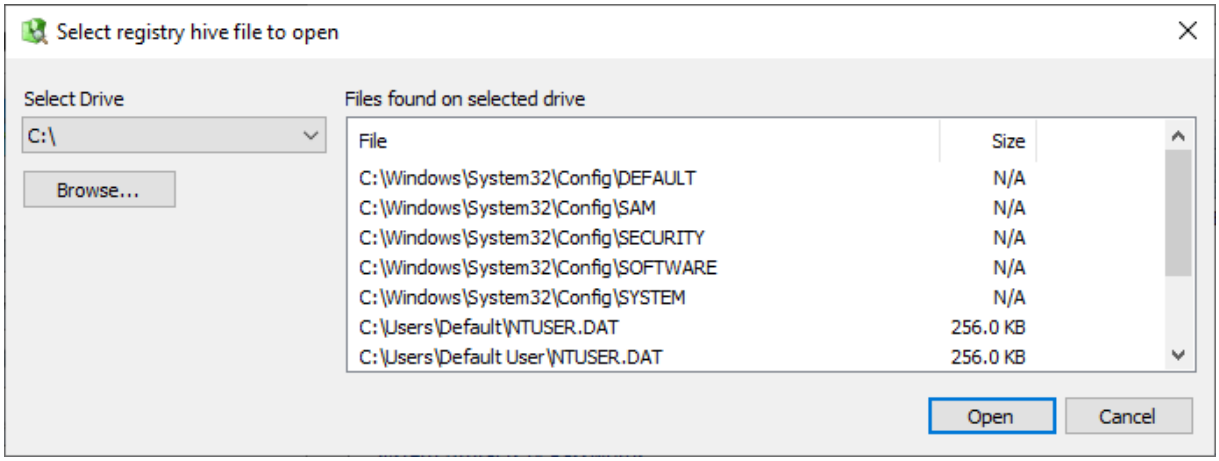



Right clicking on an item in the list view will allow you to copy the value's location (full key name and the value name), value data and to add the item to a save as a HTML os CSV formatted document.

## Opening a Registry File

Clicking the "Registry Viewer" icon on the Start tab of OSForensics will open a dialog that will allow you to pick a registry file to open. When a drive is selected, the known locations of registry files as well as the root directory are scanned. Any registry files found will be displayed. If you have a collection of registry files in another location you can use the "Browse" button to navigate to their location and open them.




## Usage

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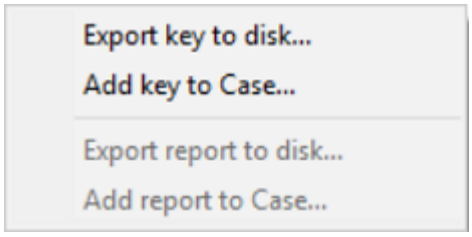
## Right-click Menu

***Registry Key Tree View***
Right-clicking a registry key in the tree view brings up the following menu:



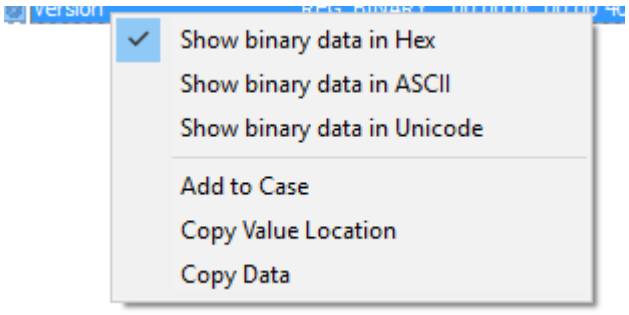

**Export key to disk...**
Save all values of the selected key as a CSV/HTML list

**Add key to Case...**
Save all values of the selected key as a CSV/HTML list and add to the case

**Export report to disk...**
Generate a CSV/HTML report of the selected registry hive. Supported registry hives include SOFTWARE, SYSTEM, SAM, and NTUSER.dat.

**Add report to Case...**
Save a CSV/HTML report of the selected registry hive to the case. Supported registry hives include SOFTWARE, SYSTEM, SAM, and NTUSER.dat.

***Registry Key Values List View***
Right-clicking a registry key value in the list view brings up the following menu:




**Show binary data in Hex**
Display all registry data of type REG_BINARY in hex format

**Show binary data in ASCII**
Display all registry data of type REG_BINARY in ASCII format

**Show binary data in Unicode**
Display all registry data of type REG_BINARY in Unicode format

**Add to Case**
Save all values of the current key as a CSV/HTML list and add to the case

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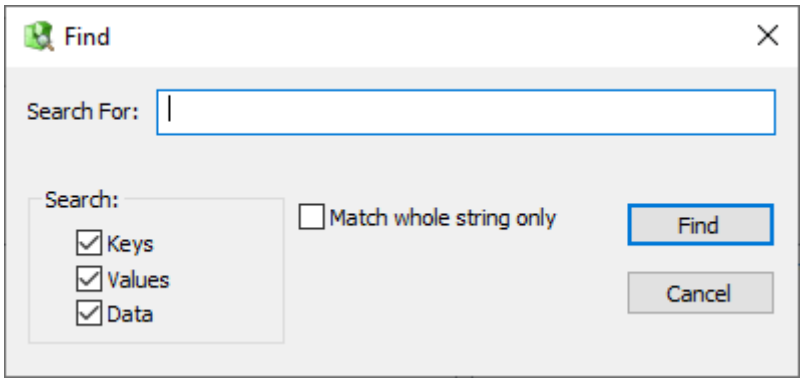
**Copy Value Location**
Copy the selected registry value location to clipboard

**Copy Data**
Copy the selected registry value data to clipboard

## Search

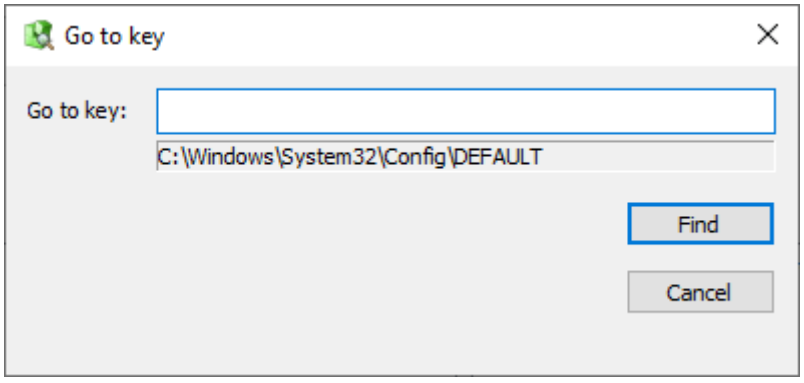
To search for a string pattern in the registry, open the 'Search' menu and select 'Find...'. In the dialog (as shown below), you can specify a search term, whether keys, values and/or data are matched, and whether the whole search string must be matched.




Once the search parameters are specified, click 'Find' to locate the next registry item that matches these parameters. You can also repeat the previous search by selecting 'Find Next' under the 'Search' menu

## Go to Key

To jump to a particular key in the registry, open the 'Search' menu and select 'Go to Key...'. Enter the desired key, then click 'Find' to select and highlight the key in the Registry Viewer.




## Exporting

To export a registry key, or entire file, open the "File" menu and select the "Export to text..." option.

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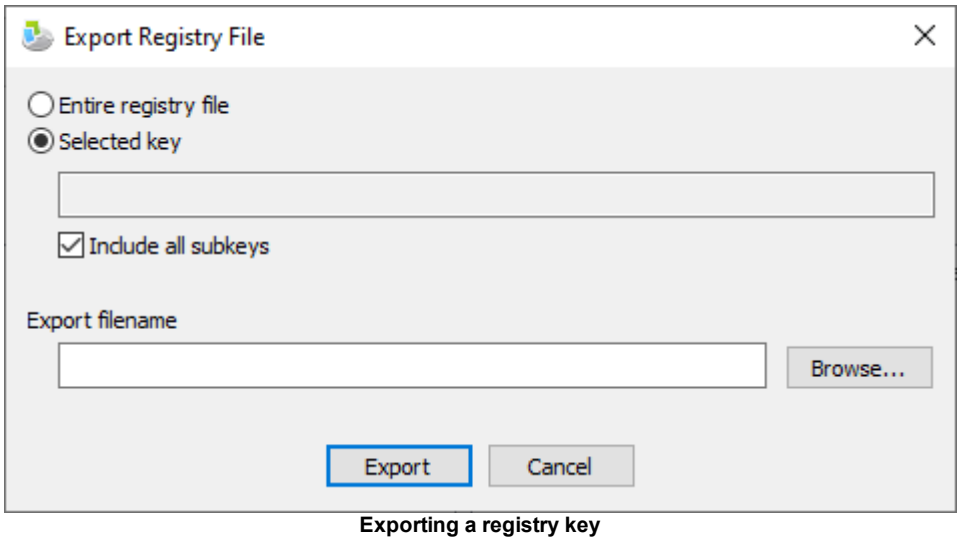


**Exporting a registry key**

## 5.28 Remote Acquisition

Remote Acquisition refers to the process of collecting forensics artifacts from machines connected to the network, without the need to perform manual, on-site live acquisition. The ability to perform simultaneous collection of digital evidence over the network greatly reduces the investigation time over offline methods.

OSForensics provides a step-by-step module to initiate simultaneous Auto Triage operations on remote machines.

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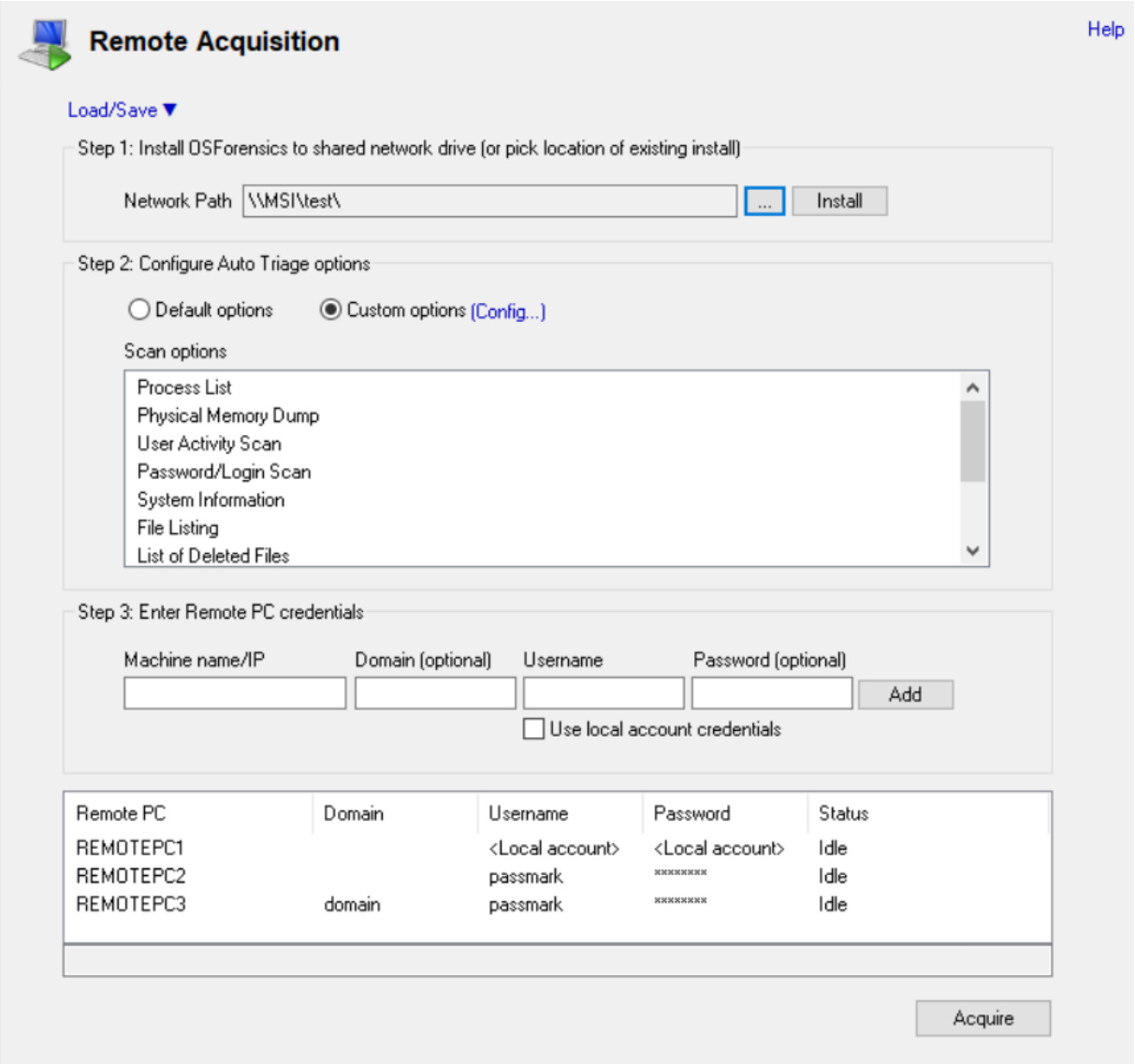


## Step 1: Install OSForensics to shared network drive

To enable acquisition of forensics artifacts on remote machines, a network install of OSForensics Portable must be accessible on the remote machine.

Once a network share is enabled, browse to the network path of where OSForensics Portable shall be installed. Click 'Install' to Install OSForensics Portable.

## Step 2: Configure Auto Triage options

The types of forensics artifacts to be collected on remote machines can be configured in this step.

To collect a default set of forensics artifacts, select 'Default options'. Otherwise, select 'Custom options' then click on 'Config...' to configure Auto Triage Options.

## Step 3: Enter Remote PC credentials

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Next, enter the list of remote machines that collection of forensics artifacts shall be performed on.

**Machine name/IP**
Name of IP address of the Windows machine accessible on the network. Omit the initial backslashes (eg. \\REMOTEPC1) from the input.

**Domain**
Domain where the machine is located in. This field can be omitted if the machine does not belong in a domain.

*Note - Machines not belonging to a domain will require specific registry permissions to be enabled. See Troubleshooting Connection Issues for instructions.*

**Username**
The user name of an account with Administrator access on the machine

**Password**
The password associated with the account (if set).

**Use local account credentials**
Use the current user on the local machine's credentials (ie. the user session currently running OSForensics) to access the remote machine.

### Step 4: Press Acquire to initiate Remote Acquisition

*To troubleshoot connection or permission issues, See Troubleshooting Connection Issues.*

## 5.28.1 Network Drive Setup

There a several methods to create a shared network drive, some methods include:

**Shared folder**
Create a new folder on the machine to host the shared folder, then right-click and go to 'Properties' and to the 'Sharing' tab.

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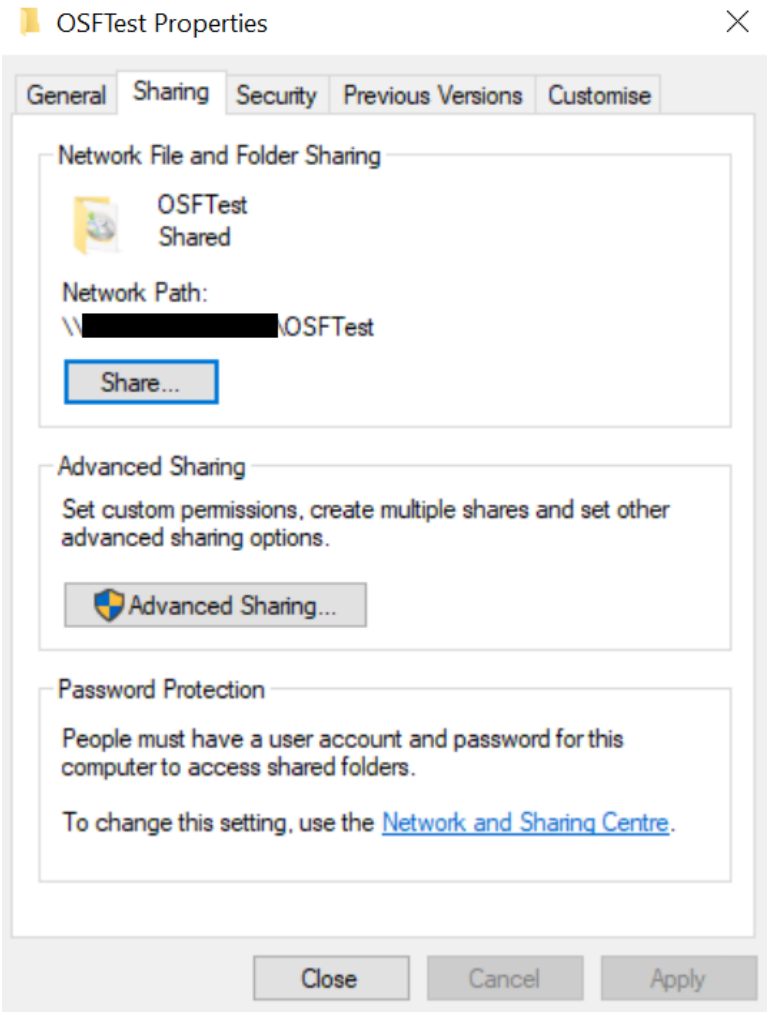


Then click on 'Advanced Sharing...' then check 'Share this folder'

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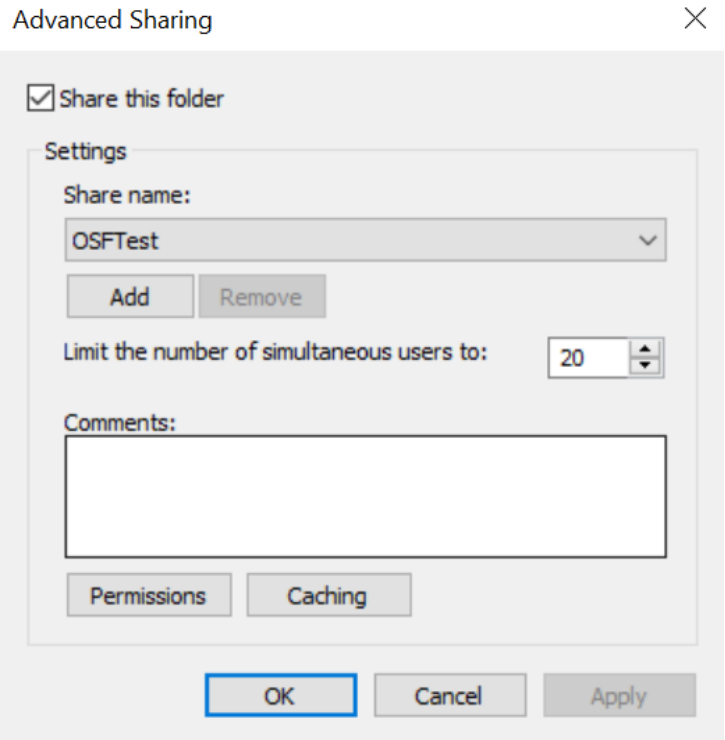


Click 'OK' then 'Close'. Then go to the machine to be remote into and check that the folder being shared can be accessed.
Enter credentials for host of the shared folder if required.

You can also change the share so everyone can access without credentials by going to the above properties window and click on 'Share...' to open the Network Access window:

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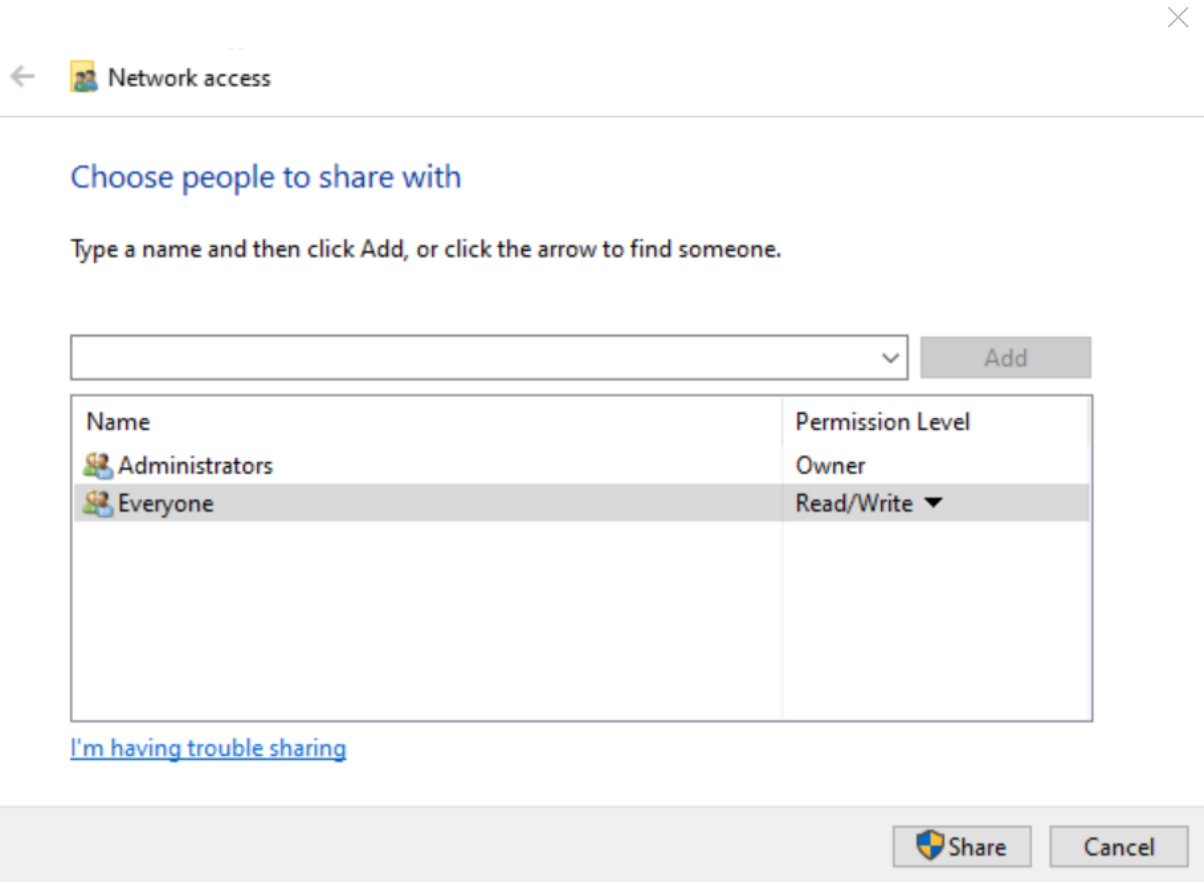


And in the drop-down menu, select 'Everyone', and 'Add'. Then change the Permission Level to 'Read/Write' using the down arrow in the same column.

**Network-attached storage (NAS)**
If you have a NAS, you can create a network folder/drive following the instructions provided by the manufacturer and make sure that both the host and remote machines can access the folder.

## 5.28.2 Troubleshooting Connection Issues

### I get an error when my login credentials does not require a password

For security reasons, Windows does not allow remote access with a blank password by default, even if it is permitted when logging in locally.

The obvious workaround is to set a password for the account. Otherwise, this security setting can be disabled as follows:

1. Press Windows+R to open the “Run” box. Type gpedit.msc, and then press ENTER
2. Navigate to **Computer Configuration > Windows Settings > Security Settings > Local Policies > Security Options**
3. Change **Accounts: Limit local accounts use of blank passwords to console logon only** to **Disabled**

### I get an "Access Denied" error even though my login credentials are correct

This may occur If the remote machine is not under a domain. In Windows Vista or newer, User Account Control (UAC) restricts remote access using an account from the local Administrators group. This is a security mechanism which prevents remote attacks from malicious parties with login credentials for a local Administrative account. This mechanism is described in further detail in the following article:
User Account Control and remote restrictions - Windows Server | Microsoft Docs

UAC restrictions do not apply if it is a domain user with Administrative access.

To disable UAC restrictions on the remote machine, the following steps need to be performed:

4. Press Windows+R to open the “Run” box. Type regedit, and then press ENTER
5. Navigate to the following registry key

   HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System

6. Locate the **LocalAccountTokenFilterPolicy** registry entry. If it doesn't exist, create one by opening the right-click menu and selecting **New > DWORD (32-bit) Value**
7. Double click **LocalAccountTokenFilterPolicy** to modify the value
8. Type **1** in the Value data field
9. Exit Registry Editor

### I see the remote machine under Network but get "Remote PC not found" error

Remote Acquisition requires **File and Printer Sharing** to be enabled. This can be found under **Network and Sharing Center > Advanced sharing** settings.

## 5.29 Script Player

To support workflow automation of common or complex forensic tasks, scripts can be developed and executed in the Script Player to automate OSForensics discovery and analysis tasks. By developing and maintaining scripts as part of the forensics workflow, standard tasks and procedures can be repeated by any investigator in order to boost efficiency, minimize human error and reduce training costs. Scripts are written using the Python language, and can access OSForensics analysis via the OSForensics Python API implemented as a Python module.

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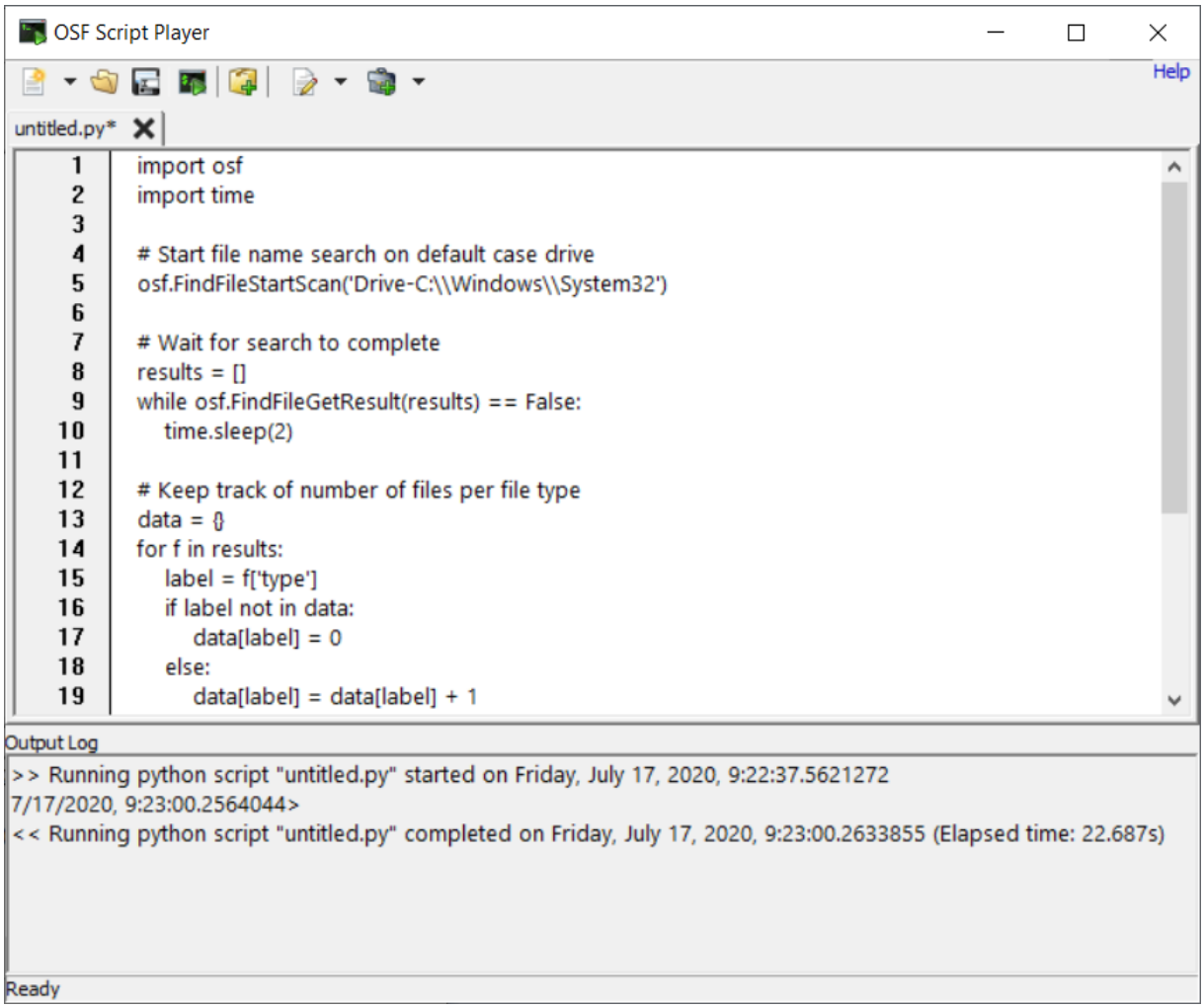


## Getting Started

To start developing scripts, click on the 'New Script' icon to open a new tab with a blank script template, or click on the drop-down button to select a built-in template script.

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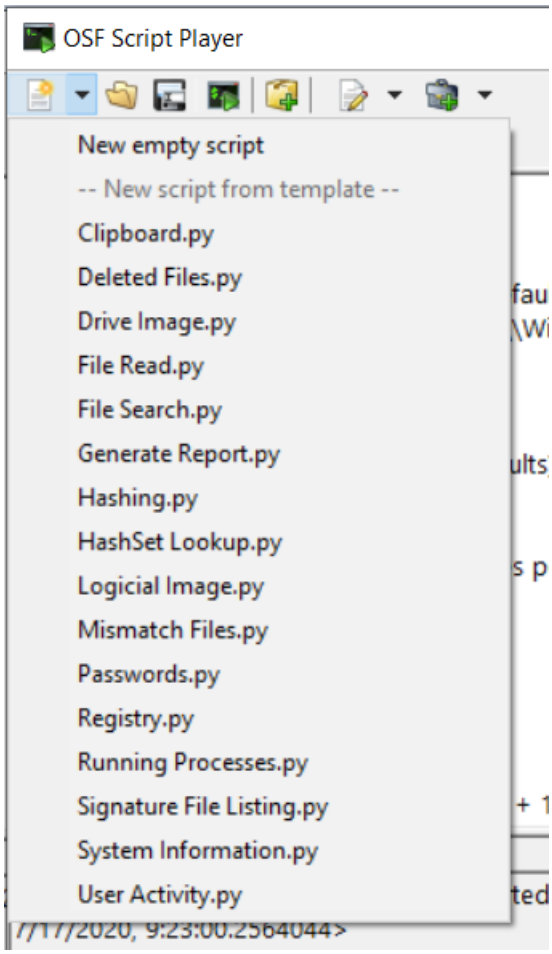


The built-in template scripts provide a starting point for using OSForensics Python API, which can be extended to building more sophisticated scripts

An existing script can also be opened by clicking on the 'Open Script' icon.

Scripts are written in the Python language, which access the OSForensics functionality via the provided `osf` Python module. This module defines a list of methods that allows forensic tasks to be performed without needing to manually perform the operation using the GUI. These methods can be called within your scripts, allowing the returned data to be manipulated further by importing built-in or 3rd party Python packages. For example, Python AI packages can be used to train image recognition models using the images returned from an OSForensics File Search.

See the Python API Reference for code examples.

## Running Scripts

Once the script is ready to be executed, click on the Run Script' icon. The output of the script execution, including syntax errors, is shown in the Output window.

To export or save the output to the case, click on .the 'Export output to file' or 'Add output to case' icons, respectively.

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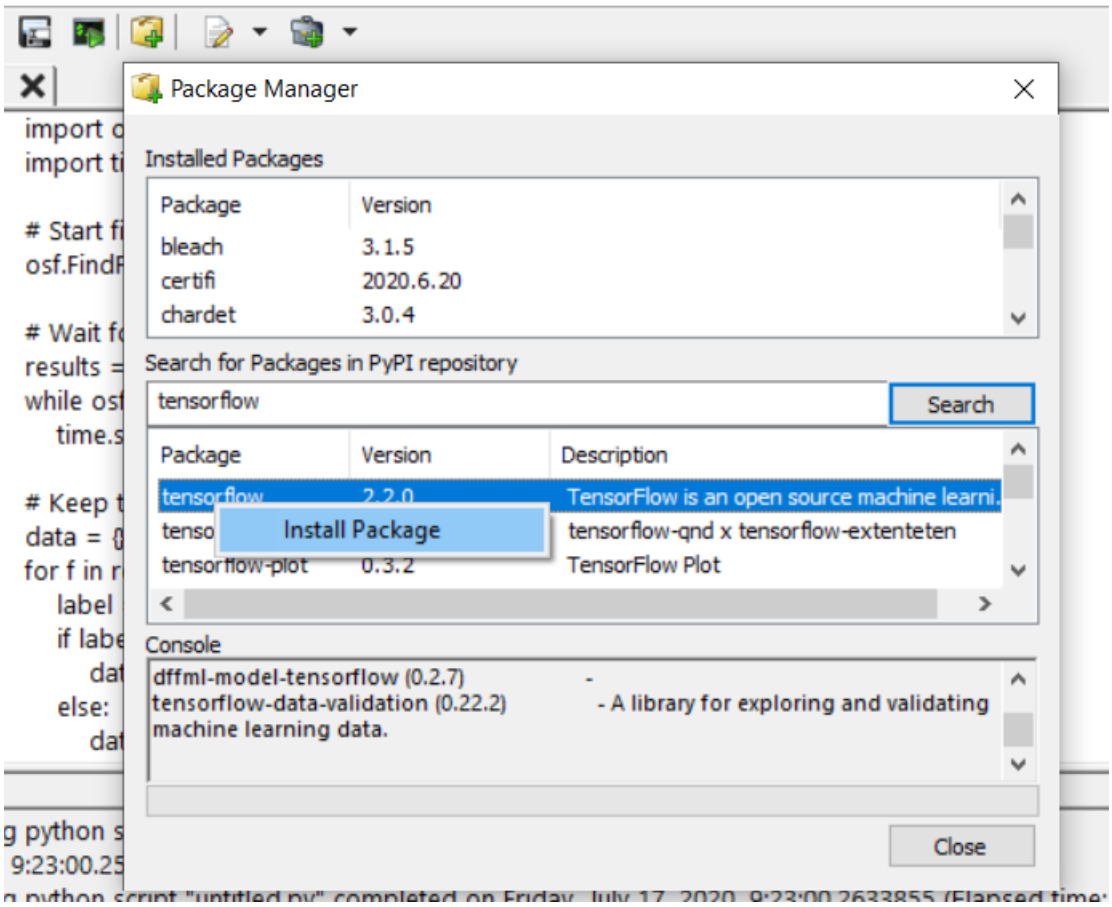
## Installing Packages

Importing 3rd party Python packages requires installation via a Python package manager (pip). Click on the 'Package' icon to open the Package Manager.




To search or install a Python package, enter the (partial) name of the package and click 'Search'. Right-click the desired package and select 'Install Package'.

To remove or upgrade a package, right-click the package under 'Installed Packages' and select 'Remove Package' or 'Upgrade Package' respectively.

### 5.29.1 Python API Reference

See Python API for OSForensics for API specifications.

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# 5.30 Signatures

Signatures allow users to identify changes in a directory structure between two points in time. Generating a signature creates a snapshot of the directory structure, which includes information about the contained files' path, size and attributes. Changes to a directory structure such as files that were created, modified and deleted can be identified by comparing two signatures. These differences can quickly identify potential files of interest on a suspected machine, such as newly installed software or deleted evidence files. Signatures differ from Hash Sets in the following ways:

1. The signature is not required to contain any file hashes
2. The file path, size and attributes of the files on the hard drive are included in the signature.

OSForensics provides the following File Signature Analysis functionality:

### Create Signature
Module that handles all aspects of generating a signature.

### Compare Signature
Module that allows the user to compare previously generated signatures. A summary of any changes between the signatures are displayed to the user.

#### Other Uses

In addition to finding any suspicious changes to a system, signatures can be used for the following

- Finding the details of intentional changes, and creating a hash set based off a signature comparison.
  - For instance it can find all the files the an application's installer package makes to a system, including the total file size of those changes. Once these changes are found they can then be turned into a hash set that defines all the files related to that application.
- Determining whether two machines have any documents / photos / videos in common. (eg. due to the sharing of files)
- Making a list of all files on a drive.

## 5.30.1 Create Signature

The Create Signature module is used for creating a signature file. This is used for creating a snapshot of a system's directory structure at a particular point in time.

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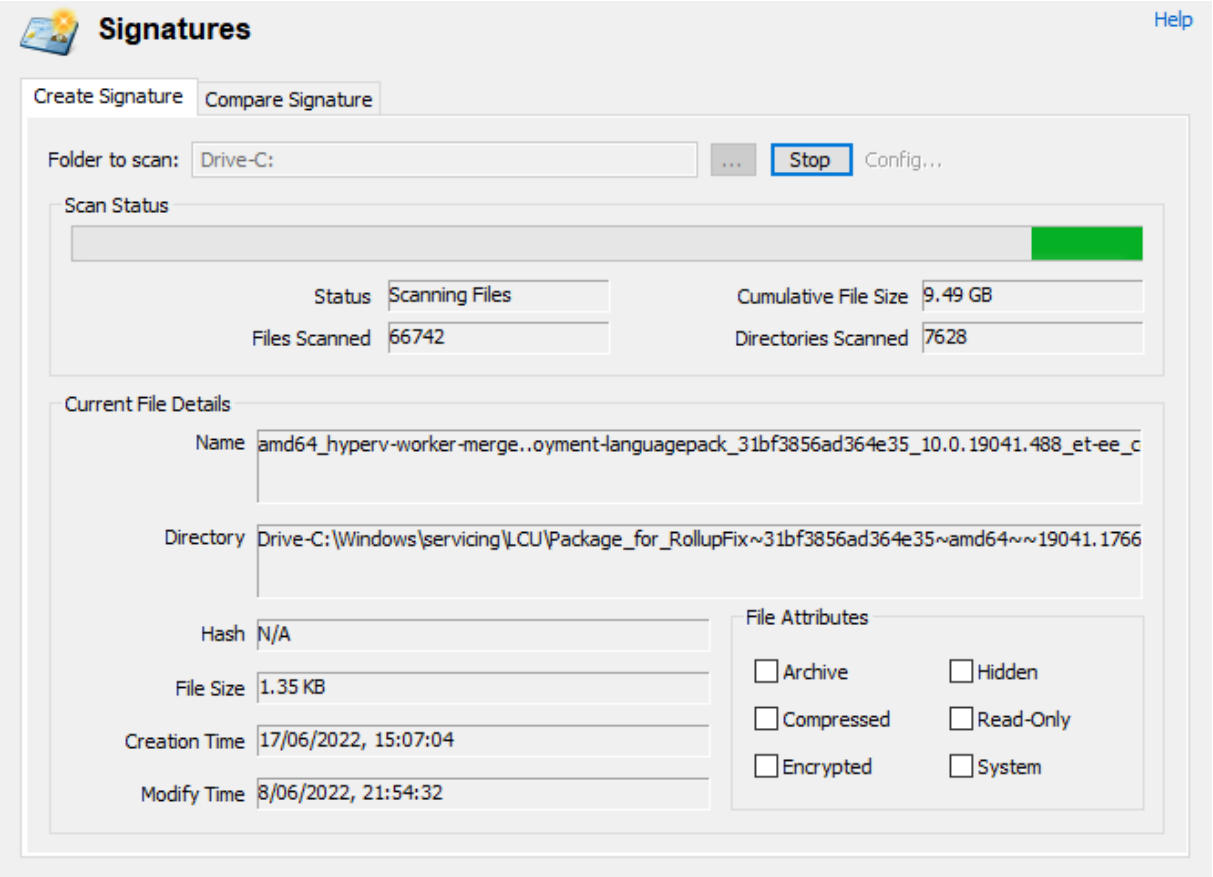


A signature can be created using the default options by simply specifying a starting directory and clicking the *Start* button. Advanced options for signature generation can be found by clicking the *Config...* link to open the Create Signature Configuration Window.

After the signature has been created, the user will be prompted to save the file signature. Saving should only take a couple of seconds, even for very large signatures.

The signature creation process can be canceled at any time by clicking the Stop button.

#### 5.30.1.1 Create Signature Configuration

The Signature File Creation Configuration windows allows for more advanced configuration of the signature creation process. This window can be accessed by clicking on the "Config..." button in the main Create Signature window.

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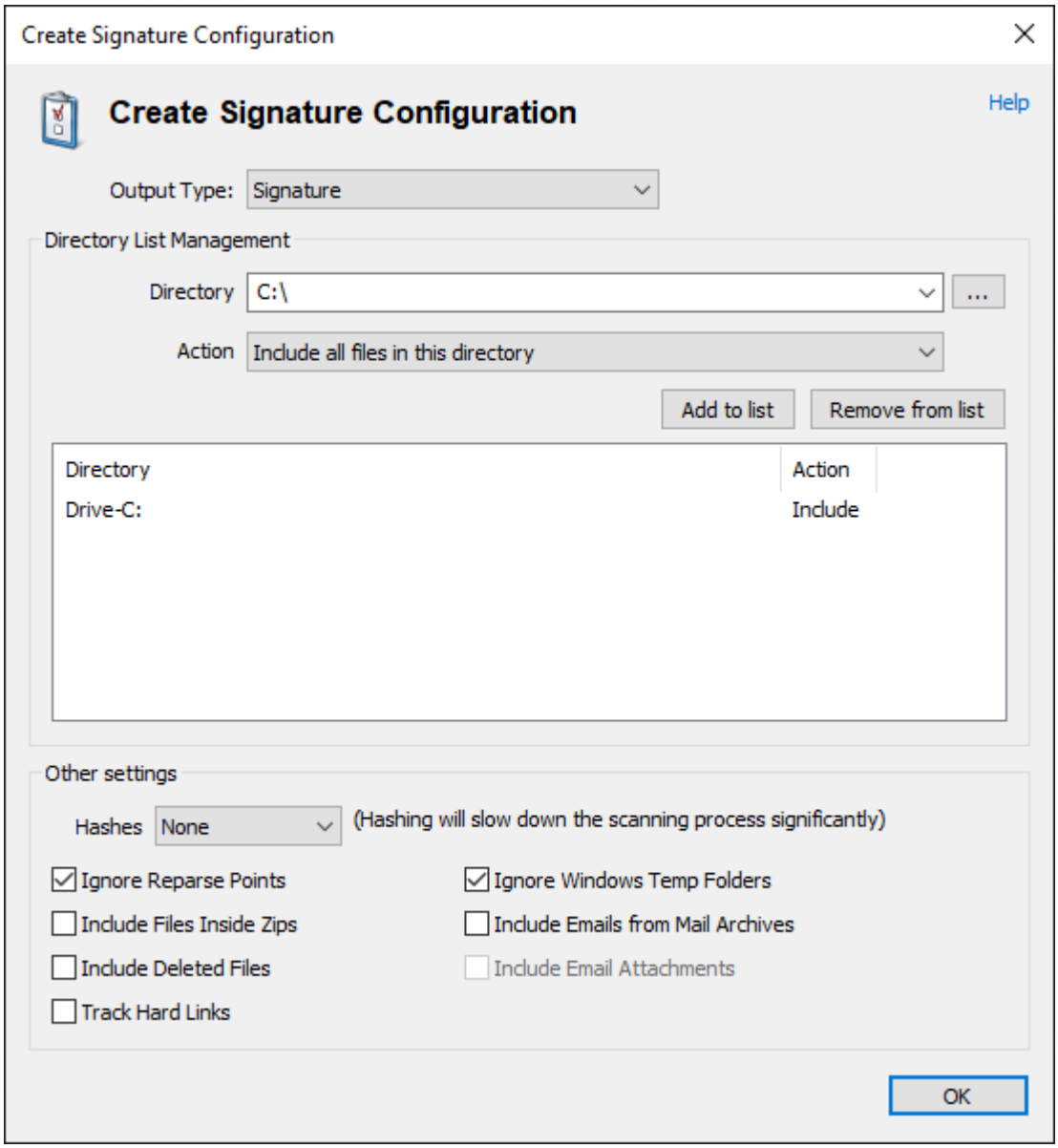


## Directory List

Directories to be included/excluded from the signature can be configured here. When a signature is being created, each include directory shall be recursively scanned and included in the signature file. Excluded directories will be skipped during the recursion. Note that if an include directory in the list contains another include directory in the list, the common files will be included twice in the signature file.

You can include paths from the registry, the directory selection drop list has the registry root keys that can be added. Registry sub paths can be included/excluded the same as file system paths.

## Other Settings

### Calculate Hashes

Check this box to calculate an SHA1 or MD5 hash for every file in the signature. This will add a second step to the signature creation process that takes a significantly larger amount of time than a simple scan as every file in the signature needs to be read in its entirety off the hard drive. This option is disabled by default.

When creating a signature of registry paths this will hash the data stored in the registry values. Hashing of the registry has a far smaller performance penalty than the file system as there is a lot less data.

**Ignore Reparse Points**
Check this box to ignore reparse points. Reparse points exist on NTFS drives and appear as normal folders. However, they act as links between different parts of the file system. Windows creates a number of these reparse points in its initial install. This option is enabled by default. It is recommended that this option is checked. Otherwise the scan process may end up including the same file multiple times.

**Ignore Windows Temp Folders**
Ignores a hard coded list of the following known Windows temporary folders. This option is enabled by default.

```
"\AppData\Local\Microsoft\Windows\Temporary Internet Files"
"\AppData\Local\Temp"
"\AppData\Roaming\Microsoft\Windows\Cookies"
"\Users\All Users\Microsoft\Search\Data\Temp"
"\Users\All
Users\Microsoft\Search\Data\Applications\Windows\Projects\SystemIndex\Index
er"
"\ProgramData\Microsoft\Search\Data\Applications\Windows\Projects\SystemInd
ex\Indexer"
"\ProgramData\Microsoft\Search\Data\Temp"
"\Windows\Temp"
"\Windows\Prefetch"
"\Windows\System32\WDI"
"\Windows\System32\LogFiles"
"\Windows\System32\spool"
"\Windows\System32\config"
"\Windows\System32\winevt\Logs"
```

**Include Deleted Files**
Scan for deleted files (and $I30 slack entries, for NTFS drives) and include the files in the signature file. Enabling this option will slow down the signature creation process.

**Include Files inside Zips / Include Emails from Mail Archives**
Selecting these options will have the signature creation function examine the contents of zip files or email archives. In the case of emails extra meta data (ie. to and from addresses) will be stored. Attachments of emails will also be added as separate entries Note that these options are recursive, if there is a zip file inside a zip file or an email archive within an email they will also be examined. If both options are selecting zips attached to emails will be examined as well as email archives inside zips. There is no fixed limit as to how deep the recursion will go.

**Track Hard Links**
Selecting this option will have the signature creation function track hard links for each file. A hard link is the file system representation of a file by which more than one path references a single file on the same volume. When enabled, only the first encounter of file is added to the total file size. Subsequent encounters of hard links to the file will not increase the total file size. Enabling this option will slow down the signature creation process. Only supported for folders on NTFS.

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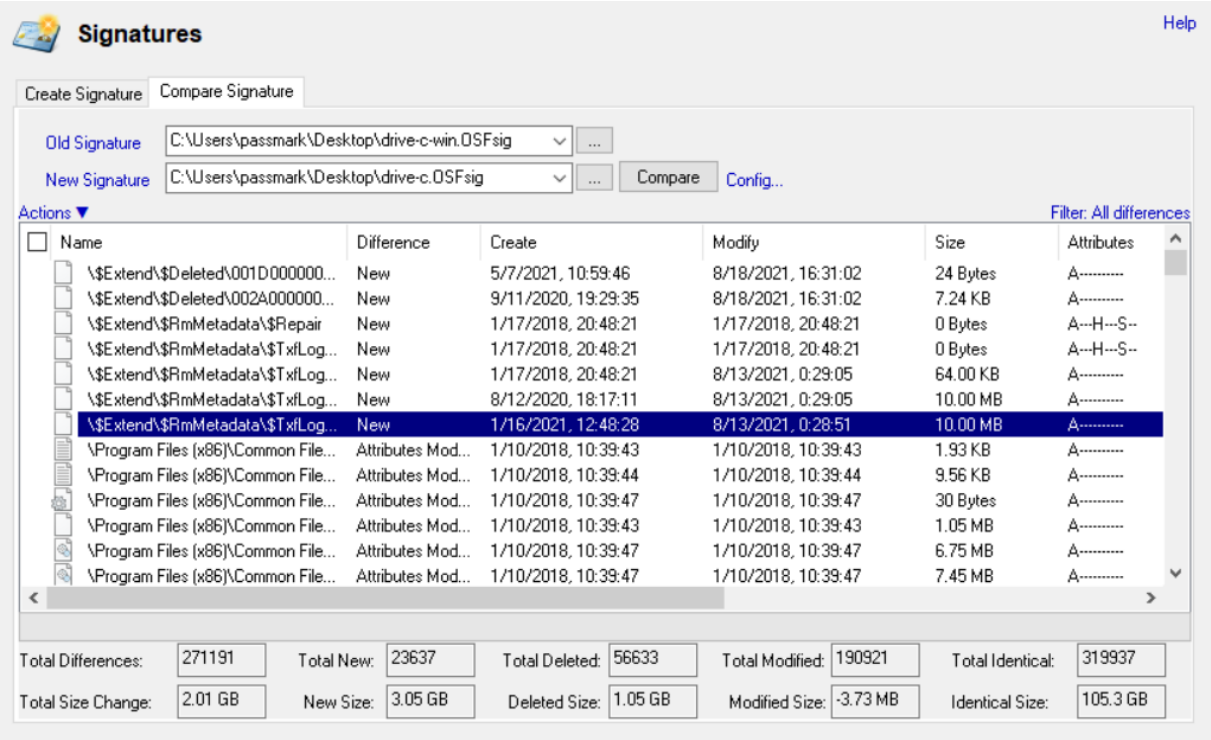
## 5.30.2 Compare Signature

The Compare Signature module is used for comparing two previously created signatures, in order to identify differences in the directory structure between two points in time. Differences include new files, modified files and deleted files.




**Old / New Signature**
The file path of the signature files to compare. The chronologically older of the two signatures should be the "Old Signature" so that the terminology of the differences are correct.
Clicking on the *Old Signature/New Signature* link opens the Signature Info window which displays the details of the corresponding signature file.

**Compare**
Click this button to perform the comparison between the signature files.

**Config...**
Open a configuration dialog which allows the user to adjust the signature comparison settings.

**Filter**
Filter the results by new, deleted, modified or identical files

### Actions Menu

**Export to file...**
Click this button to save the results of the signature comparison to a CSV file.

**Create Hash Set...**

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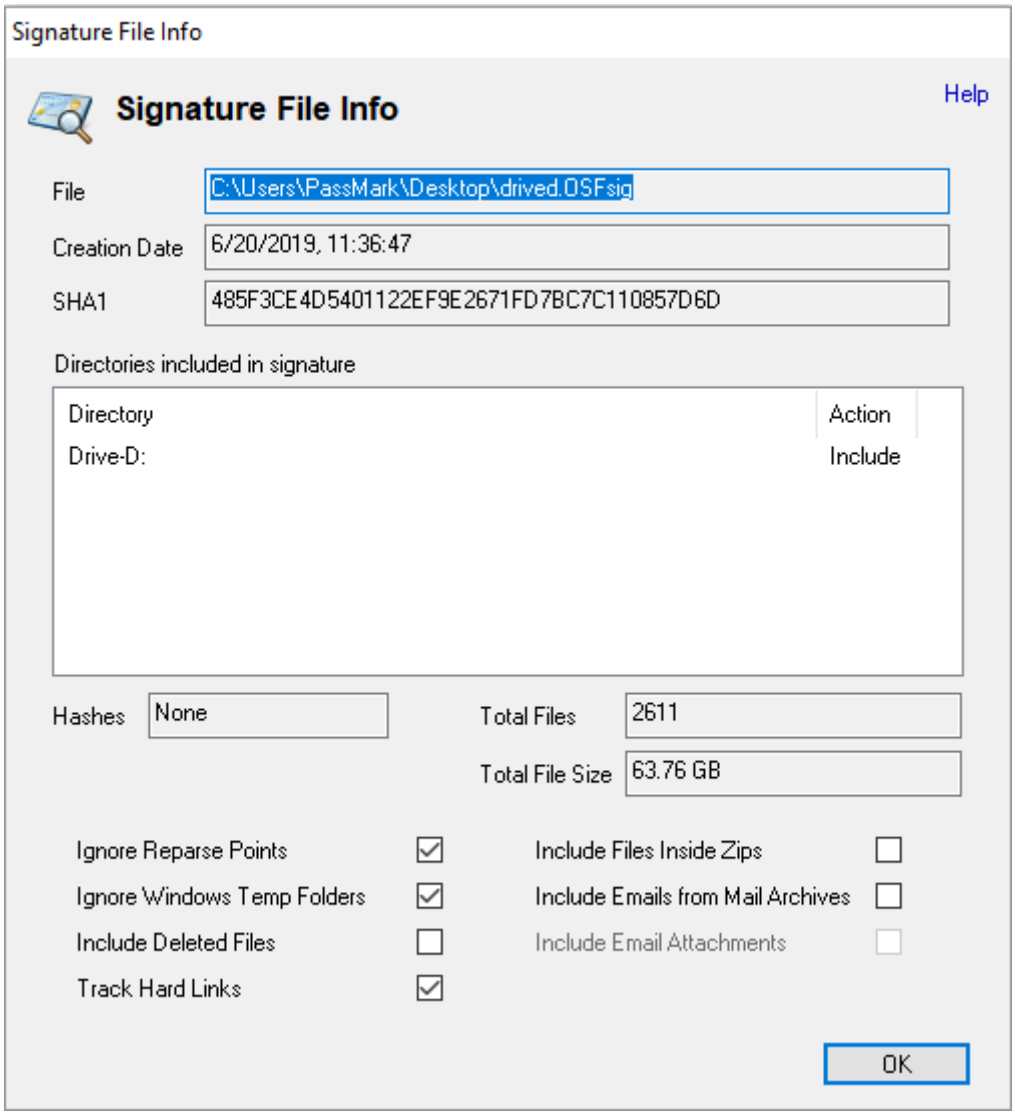
Click this button to create a Hash Set using the list of differences from the comparison.

#### 5.30.2.1 Signature Info

The Signature Info Window shows the details about the signature file. This window can be accessed by clicking on the "Info" button on a signature file in the main Compare Signature window.




**File**
The file path of the signature file.

**Creation Date**
The date and time of when the signature file was created.

**SHA1**
The internal SHA1 hash of the signature. Note that due to the fact that the SHA1 hash is stored within the signature itself, running the hash function over the signature file will not generate the same hash.

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The hash is however recalculated and checked upon loading the signature and an error will appear if the signature has been modified.

**Directories included in signature**
The list of directories included/excluded in the creation of the signature file.

**Hashes**
This field will specify what type, if any, hashes were calculated for the entries in this signature.

**Total Files**
Total number of entries in this signature.

**Total File Size**
Cumulative size of all entries in this signature.

**Ignore Reparse Points**
If checked, reparse points were ignored in the creation of the signature file.

**Ignore Windows Temp Folders**
If checked, known Windows temporary folders were ignored in the creation of the signature file.

**Include Deleted Files**
Whether or not the signature creation process included deleted files (and $I30 slack entries, for NTFS drives).

**Include Files Inside Zips**
Whether or not the signature creation process included files inside zip files.

**Include Emails from Mail Archives / Include Email Attachments**
Whether or not the signature creation process included emails and attachments from inside mail archives.

**Track Hard Links**
Whether or not the signature creation process tracked hard links. If hard links are tracked, only the first encounter of a file will be counted toward the file size and each subsequent encounter of the file will mark the file size as 0 to not increase the total file size count.

### 5.30.3 Signature Technical Details

The following is a list of notes about how signatures and file listings handle certain special cases.

#### Email Date/Times
In the case of emails the Create Date is the Sent Date and the Modify Date is the Receive Date.

#### Single Email Containers
Files that only contain a single email (ie. eml, msg) still get two entries in the signature. One for the file itself, and one for the email. This is due to the fact that some shared data can be different. There is date/times for both the file itself and when the message was sent and received. Also the file size and hash will differ, see below.

#### File Sizes of Emails
The email file size is calculated as;

Message header + Message HTML content + Message plain text content + message RTF content + size of any attachments (where supported).

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All fields except RTF are treated as double byte unicode for size purposes. RTF is left in its original single byte formatting.

The total size of all emails in a container will differ from the size of the file, in some cases total will be bigger. This is an artifact of the message HTML and plain text content always being treated as double byte, whereas internally it may have been stored as UTF-8 or some other compressed format.

### Email Attachment Limitations

MBOX Attachments are limited to 50MB. If an attachment is large than this it is not included in the signature/file listing nor counted as part of the message hash / file size.
DBX attachments are not supported in any way.

### Email Hashes

When generating hashes there are two separate hashes generated for emails. The first, which exists in the same field as normal hashes, is a hash of the content that makes up the message file size as described above in the email file size above.

The second hash is a hash of just the message content. The has is calculated on one of the three possible content fields. If more than one content type exists they are chosen in the following order of priority.

Plain text has the highest priority, it is treated as double byte unicode and all spaces, newlines, tabs and carriage returns are removed before hashing.
HTML has the second highest priority, it is treated as double byte hashed without modification.
RTF is the lowest priority, it is hashed as a single byte character string.

### Deleted File Hashes

Calculating hashes for the contents in deleted files is supported (except for $I30 slack entries). However, be aware that the deleted file clusters may have been overwritten and/or allocated to another file causing the calculated hash to be different from the original file.

### Large Zip Files

Zip archives greater than 4GB are not supported. Only the top level zip will be added to the signature, not any of the files within the zip.

### Track Hard Links

Only supported for selected folders locations that resides on NTFS.

## 5.30.4 File Listing

You can also select File Listing in the Configuration window to export a list of files in CSV format. To do this, click on the 'Config...' link, and in the configuration window, expand the 'Output Type' dropdown and select 'File Listing'.

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An example of a file listing CSV export:

| ID | ParentID | Path | Create Date/ | Create Date | Create Time | Modify Date/ | Modify Date | Modify Time | Access Date/Tir | Access Date | Access Time | Attr. Modify Dat | Attr. Modify Date | Attr. Modify | Size (bytes) | Attributes | Parent | Child |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Drive-C:\Intel\Logs\HIDEVENT | 1.3183E+17 | 10/2/2018 | 32:19.8 | 1.3183E+17 | 10/4/2018 | 13:13.6 | 1.32543E+17 | 1/4/2021 | 25:45.2 | 1.3183E+17 | 10/4/2018 | 13:13.6 | 40308 | A | FALSE | FALSE |
| 1 | | Drive-C:\Intel\Logs\IntelCPHS. | 1.3183E+17 | 10/2/2018 | 39:25.6 | 1.3183E+17 | 10/2/2018 | 39:25.6 | 1.3183E+17 | 10/2/2018 | 39:25.6 | 1.3183E+17 | 10/2/2018 | 39:25.6 | 0 | A | FALSE | FALSE |
| 2 | | Drive-C:\Intel\Logs\IntelGFX.l | 1.3183E+17 | 10/2/2018 | 06:46.1 | 1.3183E+17 | 10/4/2018 | 07:35.6 | 1.32543E+17 | 1/4/2021 | 25:45.2 | 1.3183E+17 | 10/4/2018 | 07:35.6 | 113180 | A | FALSE | FALSE |
| 3 | | Drive-C:\$AttrDef | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 2560 | HS | FALSE | FALSE |
| 4 | | Drive-C:\$BadClus | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 0 | HS | FALSE | FALSE |
| 5 | | Drive-C:\$Bitmap | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 7593792 | HS | FALSE | FALSE |
| 6 | | Drive-C:\$Boot | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 1.3183E+17 | 10/2/2018 | 05:52.6 | 8192 | HS | FALSE | FALSE |

**ID**
Unique identifier for each file

**Parent ID**
If files are part of a ZIP file, this field will be filled with the ZIP file's ID.

**Path**
Full path of where the file is located.

**Create Date/Time**
Microsoft FILETIME number for when file was created.

**Create Date**
Conversion of the above FILETIME number into a readable date.

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**Create Time**
Conversion of the above FILETIME number into a readable time.

**Modify Date/Time**
Microsoft FILETIME number for when file was last modified.

**Modify Date**
Conversion of the above FILETIME number into a readable date.

**Modify Time**
Conversion of the above FILETIME number into a readable time.

**Access Date/Time**
Microsoft FILETIME number for when file was last accessed.

**Access Date**
Conversion of the above FILETIME number into a readable date.

**Access Time**
Conversion of the above FILETIME number into a readable time.

**Attr. Modify Date/Time**
Microsoft FILETIME number for when file attributes were last modified.

**Attr. Modify Date**
Conversion of the above FILETIME number into a readable date.

**Attr. Modify Time**
Conversion of the above FILETIME number into a readable time.

**Size (bytes)**
Size of the file in bytes.

**Attributes**
File attributes, e.g. Read-only, Hidden.

**Hashes**
This can be enabled in the configuration window, you can select up to two different hashes between SHA1, SHA256 and MD5.

**Parent**
TRUE/FALSE - if file is a parent of child files.

**Child**
TRUE/FALSE - if file is child of a parent file.

## 5.31 SQLite Database Browser

The SQLite Database (DB) Browser module allows the user to analyze the contents of SQLite database files. This module provides the ability to perform a deeper inspection of the contents and the ability to open BLOBs (binary data) with the Internal Viewer.

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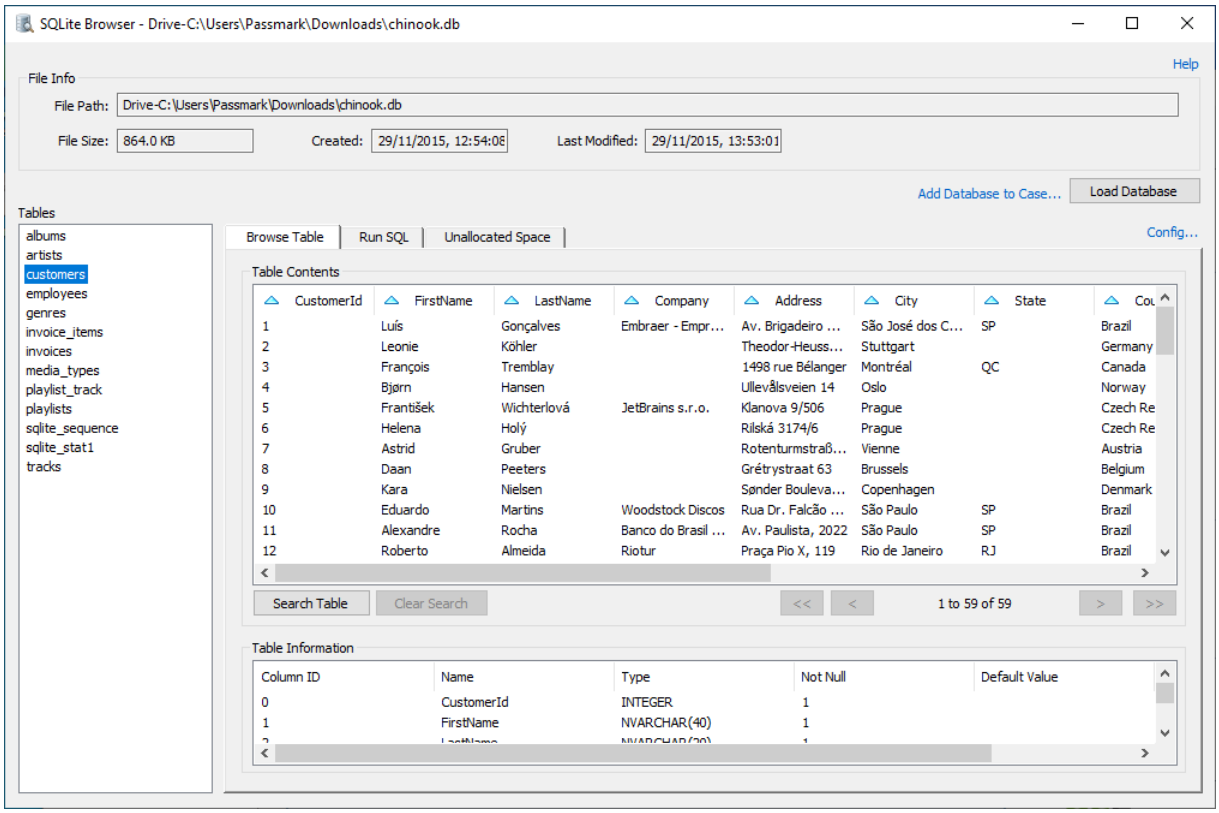
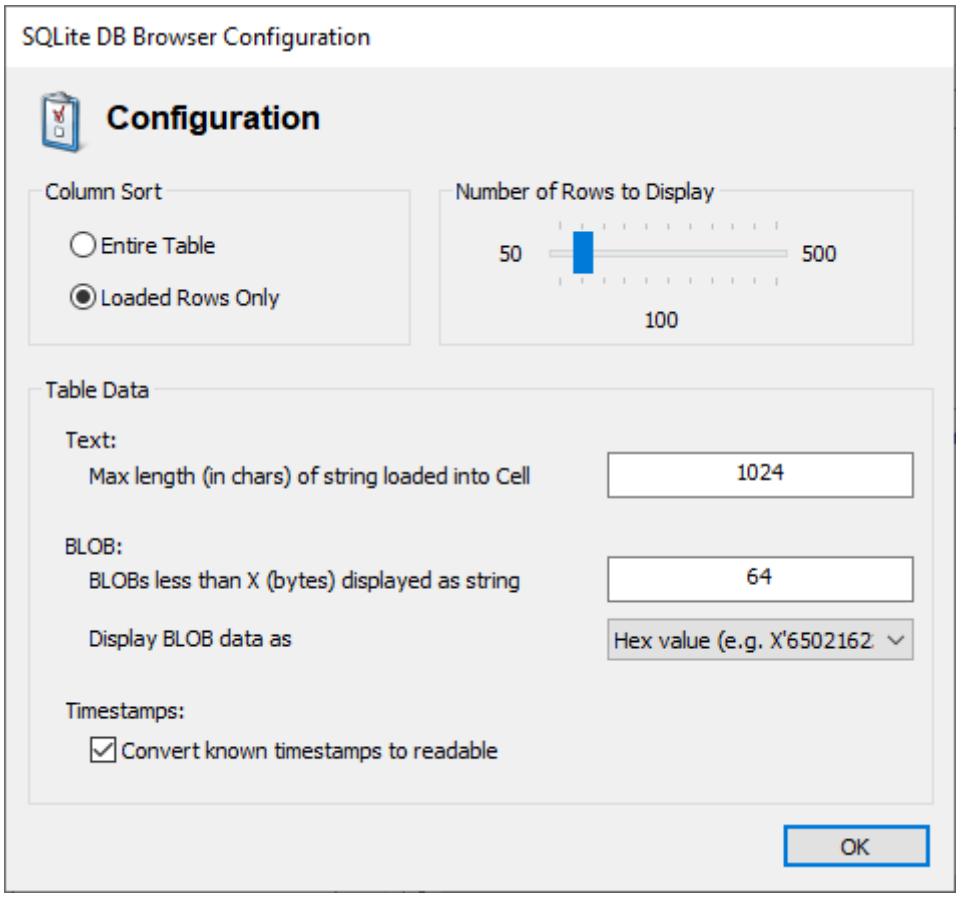



**Load Database**
Load a SQLite database file.

**Config ...**
Opens a dialog to configure the display settings of the module.




*Column Sort* – Adjust how the columns are sorted when clicking on the column header.

- Entire Table – Sort the table using the entire contents of the table.
- Loaded Rows Only – Sort the table using the rows currently loaded.

*Number of Rows to Display* - Configure the number of rows that are displayed in the table at one time.
*Table Data* -

- Text:

*Max length (in chars) of string loaded into Cell* - Specify the maximum number of characters that are displayed into each cell for Text data types.

- BLOB:

*BLOBs less than X (bytes) displayed as string***-** Blobs under the number of bytes specified will have its contents displayed. Works in conjunction with next option.
*Display BLOB data as:* - BLOBs less than the bytes specified in the previous option will display its contents as **String** data or as **Hex** representation.
*Timestamps: Convert known timestamps to readable* - Identified and known timestamps field will display the value as a readable string along with the original timestamp value, e.g. "9/14/2017, 13:07:17 (13149893237645538)"

**Scan Folder**
Scans a folder for possible SQLite database files. Selecting a file on the file list will open the database in the viewer.

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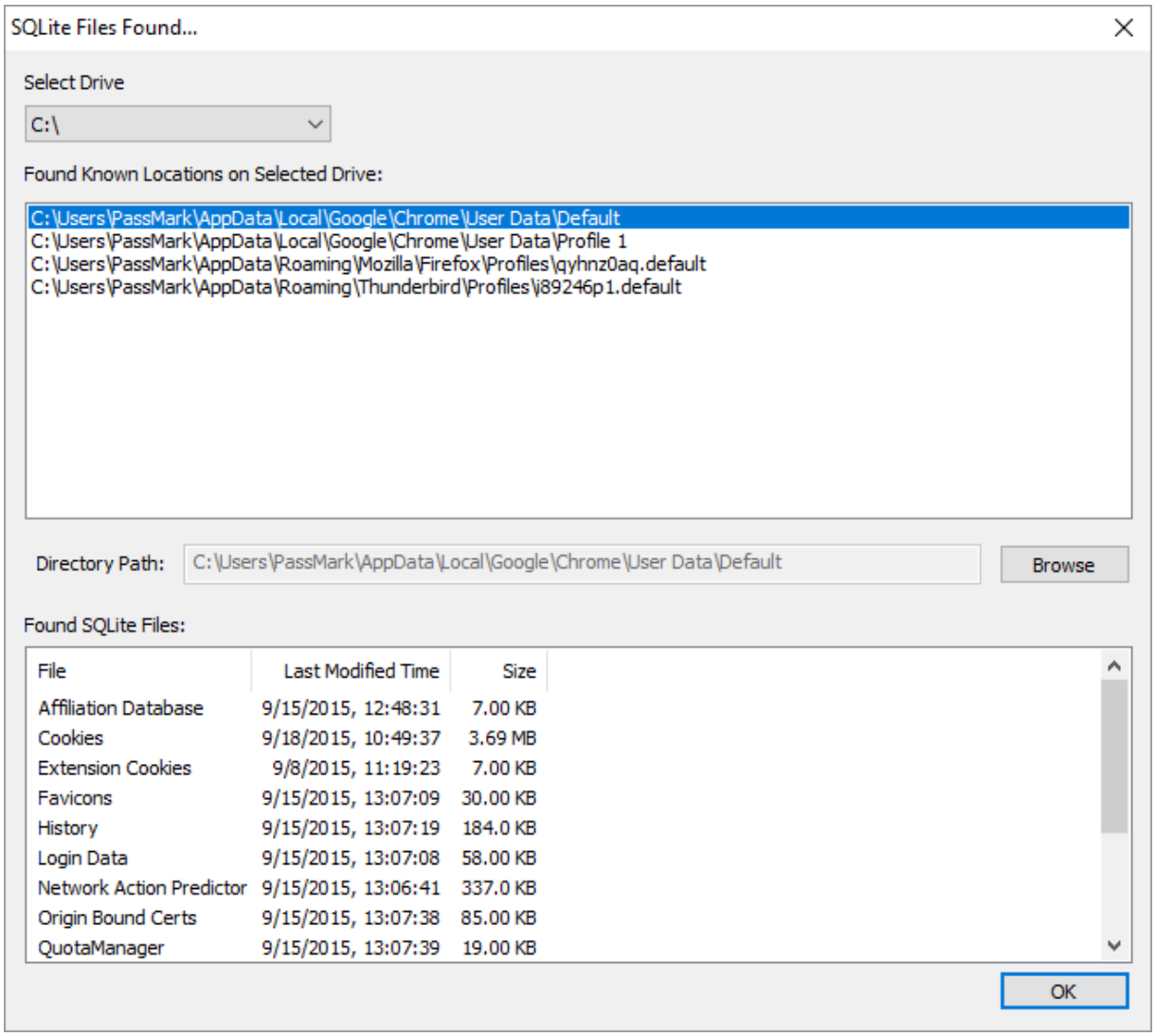


## Table List

Shows the available tables in the loaded SQLite DB file. Selecting a table will load the contents in the adjacent **Table Contents** section.
Right clicking on a table will allow the user to "*Add selected table to case".*

**Add DB to Case**
Allows the user to add the current SQLite file to the current case.

## Table Contents

The view will show the contents of the current loaded table or the output from a custom search query.

**Search Table**
Opens a search window that allows users to perform custom queries on the current loaded table. The results will be updated in the result table.

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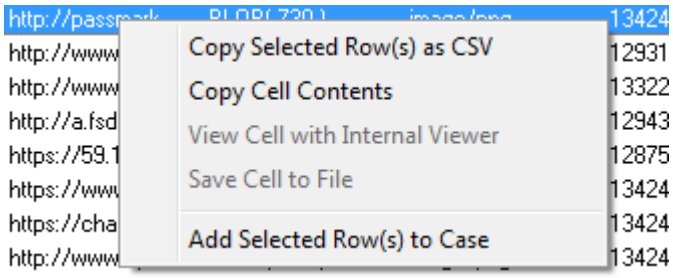
**Clear Search**
This button will be enabled when a custom search has been preformed. Selecting this will clear the custom query and reload the selected table.

Right clicking a cell will bring up a menu that will allow you to accomplish various tasks.

## Right click menu




**Copy Selected Row(s) as CSV**
Copy the selected rows to the clipboard in CSV format.

**Copy Cell Contents**
Copy the cell contents to the clipboard.

**View Cell with Internal Viewer**
Available only on binary/BLOB cells. The cell will be open with the OSForensics' Internal Viewer.

**Save Cell to File**
Available only on binary/BLOB cells. Allows saving the contents to a file.

**Add Selected Row(s) to Case**
Allows the user to add the current selected rows to the current open case.

## Search Table

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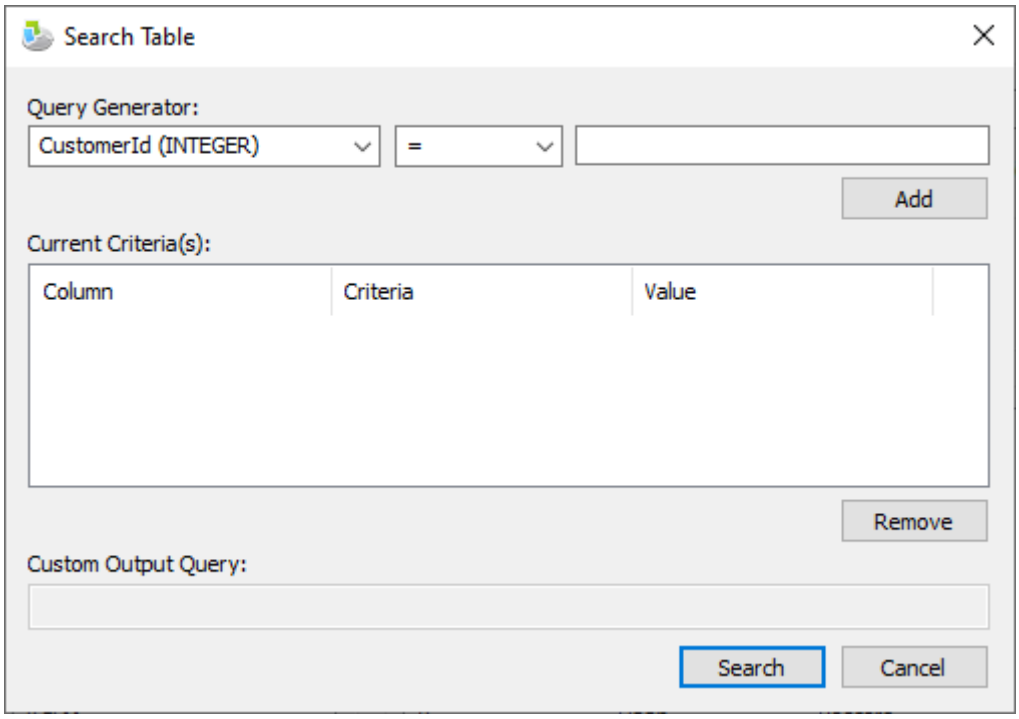
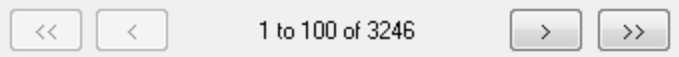



**Query Generator**
The first drop down box will be pre-populated with the column names for the loaded table. The second drop down box sets the criteria to be used on the chosen column. The text field allows further customization of the search criteria. The **Add** button will add the constraint to the query list.

**Criteria**
Shows a list of currently selected query constraints. To remove a constraint, select the criteria and click the **Remove** button.

**Custom Output Query**
Will show the query that will be performed on the SQLite table.

## Navigation Buttons




**<<**
Jump to the beginning (i.e. start with row 1) of the table.

**<**
Previous page.

***X to Y of Z***
Shows that rows from X to Y are loaded. Z is the total number of rows.

**>**

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Next page.

**>>**
Jump to the end of the table.

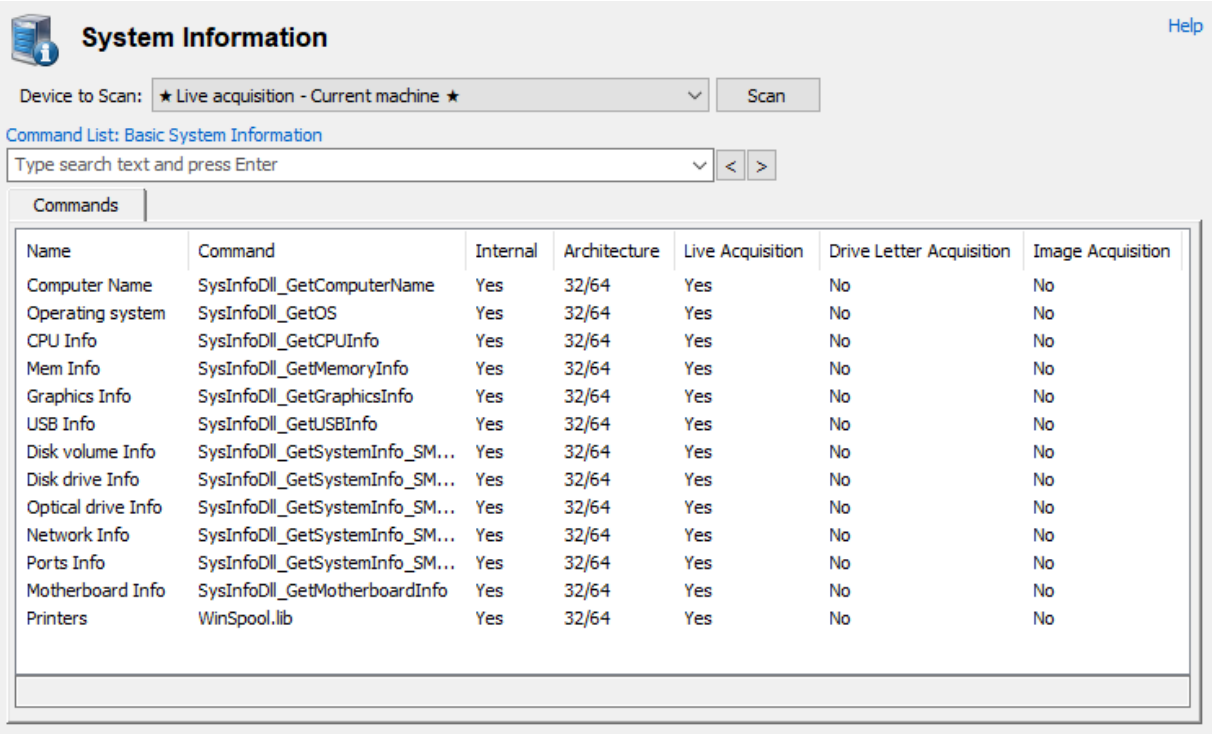
### Table Information

Shows the table structure of the currently loaded table.

## 5.32 System Information

The System Information module allows retrieval of detailed information about the core components of the system. This module comes with built-in test test lists that can retrieve the core details about the system such as;

- CPU, Motherboard and Memory
- BIOS
- Video card/Display devices
- USB controllers and devices
- Ports (Serial/Parallel)
- Network adapters
- Physical and Optical Drives




| Name | Command | Internal | Architecture | Live Acquisition | Drive Letter Acquisition | Image Acquisition |
|---|---|---|---|---|---|---|
| Computer Name | SysInfoDll_GetComputerName | Yes | 32/64 | Yes | No | No |
| Operating system | SysInfoDll_GetOS | Yes | 32/64 | Yes | No | No |
| CPU Info | SysInfoDll_GetCPUInfo | Yes | 32/64 | Yes | No | No |
| Mem Info | SysInfoDll_GetMemoryInfo | Yes | 32/64 | Yes | No | No |
| Graphics Info | SysInfoDll_GetGraphicsInfo | Yes | 32/64 | Yes | No | No |
| USB Info | SysInfoDll_GetUSBInfo | Yes | 32/64 | Yes | No | No |
| Disk volume Info | SysInfoDll_GetSystemInfo_SM... | Yes | 32/64 | Yes | No | No |
| Disk drive Info | SysInfoDll_GetSystemInfo_SM... | Yes | 32/64 | Yes | No | No |
| Optical drive Info | SysInfoDll_GetSystemInfo_SM... | Yes | 32/64 | Yes | No | No |
| Network Info | SysInfoDll_GetSystemInfo_SM... | Yes | 32/64 | Yes | No | No |
| Ports Info | SysInfoDll_GetSystemInfo_SM... | Yes | 32/64 | Yes | No | No |
| Motherboard Info | SysInfoDll_GetMotherboardInfo | Yes | 32/64 | Yes | No | No |
| Printers | WinSpool.lib | Yes | 32/64 | Yes | No | No |

Once the commands have executed the output will appear on the results tab and can then be saved to a file or to case.

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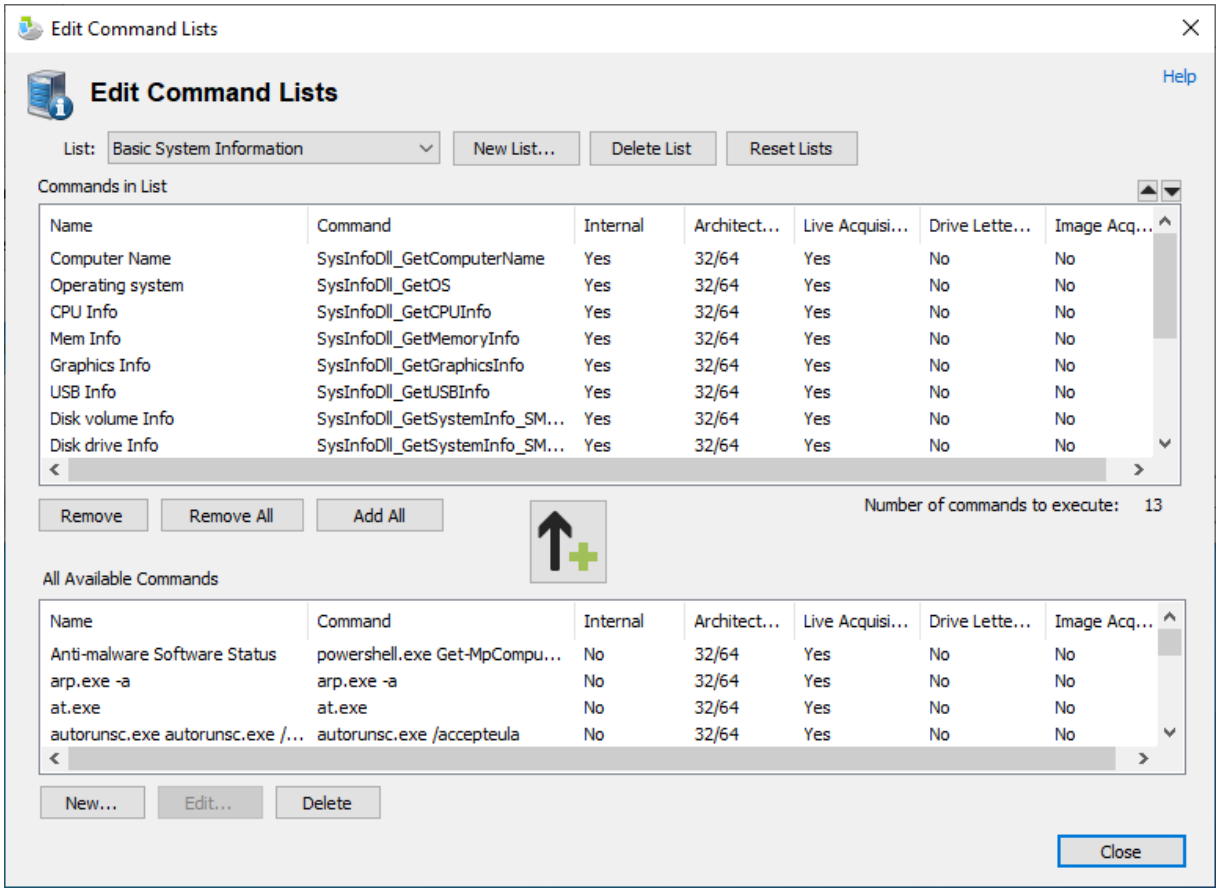
The default *Basic System Information* list can only be run on the local live system (Live acquisition only).

The *System Information From Registry* list can be run on either the local system or on a specified drive letter, device or image.

The *Python Scripts* list and any external tools commands that have been added by a user will run on either the live system or a drive letter specified in the command itself.

While OSForensics comes with several default command lists that can gather a fair bit of useful information you may want to customize or add to these lists. By clicking the *Command List* link and selecting *Edit Command Lists...* drop-down option, you can go to the list management window.




New external tools and Python scripts can be added using the Add button below the list of all commands supported. Also note that some of the default supported commands require external tools to be installed. See the External Tools page for more information.

The following commands will search for registry files available on the drive selected or the live system depending on the option selected:

- *Get Computer Name (Registry)*
- *Get Timezone Info (Registry)*
- *Get Network Info (Registry)*

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- *Get User Info (Registry)*

If you have a number of different commands selected and have not selected *Live acquisition*, then only the commands that support changing their target location (the registry command mentioned above) will run on this drive letter while the others will execute at their default locations.

**Get User Info (Registry)**
Information collected by this command is read from the SAM registry file. The account creation date is taken from the registry key creation time for the user while the other dates are read from the "F" value for the user entry.

If running on a live system you will receive a warning message about changing permissions on the registry keys in order to access it. If you continue then some dates in the registry will be altered (for example the user account creation date that is displayed). To avoid this you can add the C drive to the case in forensics mode (eg Drive-C) and run the command on Drive-C.

### 5.32.1 External Tools

New third party tools can be easily added to the test suite. There are many applications which can be helpful in retrieving system information. These tools must first be installed if these commands will run correctly.

## External Tools Directories:

To install a new external tool simply place it in one of the following folders depending on your operating system;
Vista / Win7: C:\ProgramData\PassMark\OSForensics\SysInfoTools\
XP: C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\SysInfoTools\

To install a new Python script simply place it in one of the following folders depending on your operating system;
Vista / Win7: C:\ProgramData\PassMark\OSForensics\Python\
XP: C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\Python\

To add a new Python module/library simply place it in one of the following folders depending on your operating system;
Vista / Win7: C:\ProgramData\PassMark\OSForensics\Python\OtherLibs
XP: C:\Documents and Settings\All Users\Application Data\PassMark\OSForensics\Python\OtherLibs

## Adding New Commands:

To use one a new tool you added to this folder you need to add a command from the list management window using the add button below the list of all commands supported.

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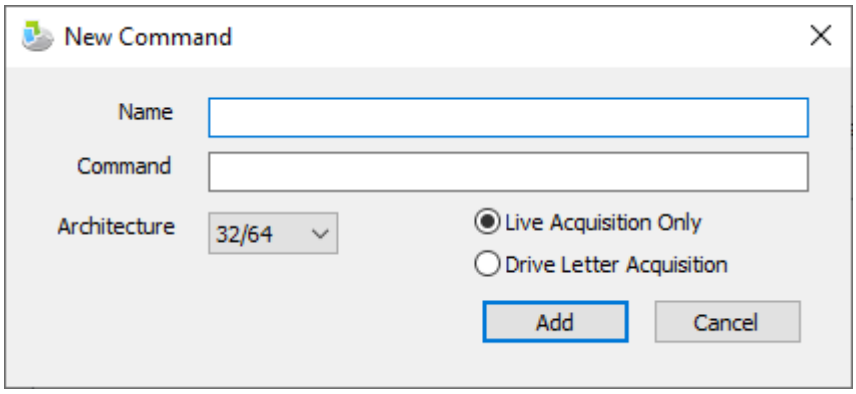


The command should be the executable with any command line parameters needed. External commands that specify .py extension will be considered a Python script and ran through the Python Interpreter. By default OSForensics gathers data from the command line output of the tool. There are also wildcards that can be used to have OSForensics fill in the details at run time.
%d: Places a drive letter in the form "c:", the drive letter is the current cases default drive or c if no case is open
%t: Inserts a path to a temp file, when this command is specified OSForensics will gather data from this file rather than from the command line output of the command.

Architecture specifies whether this command should be restricted to 32 or 64 bit systems.
The "Live Acquisition only" option specifies that the command should only run when during a live acquisition, otherwise the "Drive Letter Acquisition" should be chosen and can be executed when a drive letter is chosen for the "Scan drive" option.

There are a few internal functions of OSForensics that are able to be run on a live acquisition, on a drive letter or directly on an image (image acquisition) a that has been added to the case.

While none of the default test lists use any external tools, a number of commands are pre-configured to be added. These tools are listed here.

- Autorunsc: This tool gives comprehensive knowledge of auto-starting locations of any startup monitor.
- handle.exe: This is command line version of process explorer.
- PSTools: Its a very useful set of tools which include the following individual tools:
    - PsExec - execute processes remotely
    - PsFile - shows files opened remotely
    - PsGetSid - display the SID of a computer or a user
    - PsInfo - list information about a system
    - PsKill - kill processes by name or process ID
    - PsList - list detailed information about processes
    - PsLoggedOn - see who's logged on locally and via resource sharing (full source is included)
    - PsLogList - dump event log records
    - PsPasswd - changes account passwords

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  - PsService - view and control services
  - PsShutdown - shuts down and optionally reboots a computer
  - PsSuspend - suspends processes
  - PsUptime - shows you how long a system has been running since its

- showgrps.exe: This command-line tool shows the groups to which a user belongs within a given network domain.
- srvcheck.exe: SrvCheck is a simple ping-like program, which can check the availability of a given server. Part of Windows Server 2003 Resource Kit Tools package. Supports Windows Server 2003 and Windows XP. Not supported on 64 bit platform.

The above tools are maintained and distributed freely. These tools can be downloaded from following locations:

- Autorunsc: http://technet.microsoft.com/en-us/sysinternals/bb963902
- handle.exe:http://technet.microsoft.com/en-us/sysinternals/bb896655
- PSTools:http://technet.microsoft.com/en-us/sysinternals/bb896649
- showgrps.exe: http://technet.microsoft.com/en-us/systemcenter/bb676805.aspx
- srvcheck.exe: http://www.microsoft.com/downloads/en/confirmation.aspx?FamilyID=9d467a69-57ff-4ae7-96ee-b18c4790cffd&displaylang=en

### Notes concerning Python Scripts:

- The embedded version of Python included with OSForensics is V3.6.5
- Python Scripts only work on Live Acquisition or on System Drive Letters only.
- In normal Python, scripts that call sys.exit() would exit the program. However, to prevent scripts from closing OSForensics, OSForensics will intercept sys.exit calls from scripts. However, Python Scripts that throw SystemExit Exception explicitly can/will OSForensics process to exit immediately.
- See **External Tools Directories** above to see where scripts and library are required to be located.

## 5.33 ThumbCache Viewer

The ThumbCache Viewer is another valuable tool in OSForensics' suite of viewers for locating artifacts of files that may have been deleted on the system. In particular, the ThumbCache Viewer allows the investigators to browse thumbnail pictures stored in the cache database files. When a user opens Windows Explorer to browse the contents of folders, Windows automatically saves a thumbnail of the files in the thumbnail cache database for quick viewing at a later time. This can be useful for forensics purposes especially for cases where even though the user has deleted the original image file, the thumbnail of the image still remains in the thumbnail cache. ESE Database (Windows.edb) stores additional information of the thumbnails, such as the original full path, file size, extension, and other meta data.

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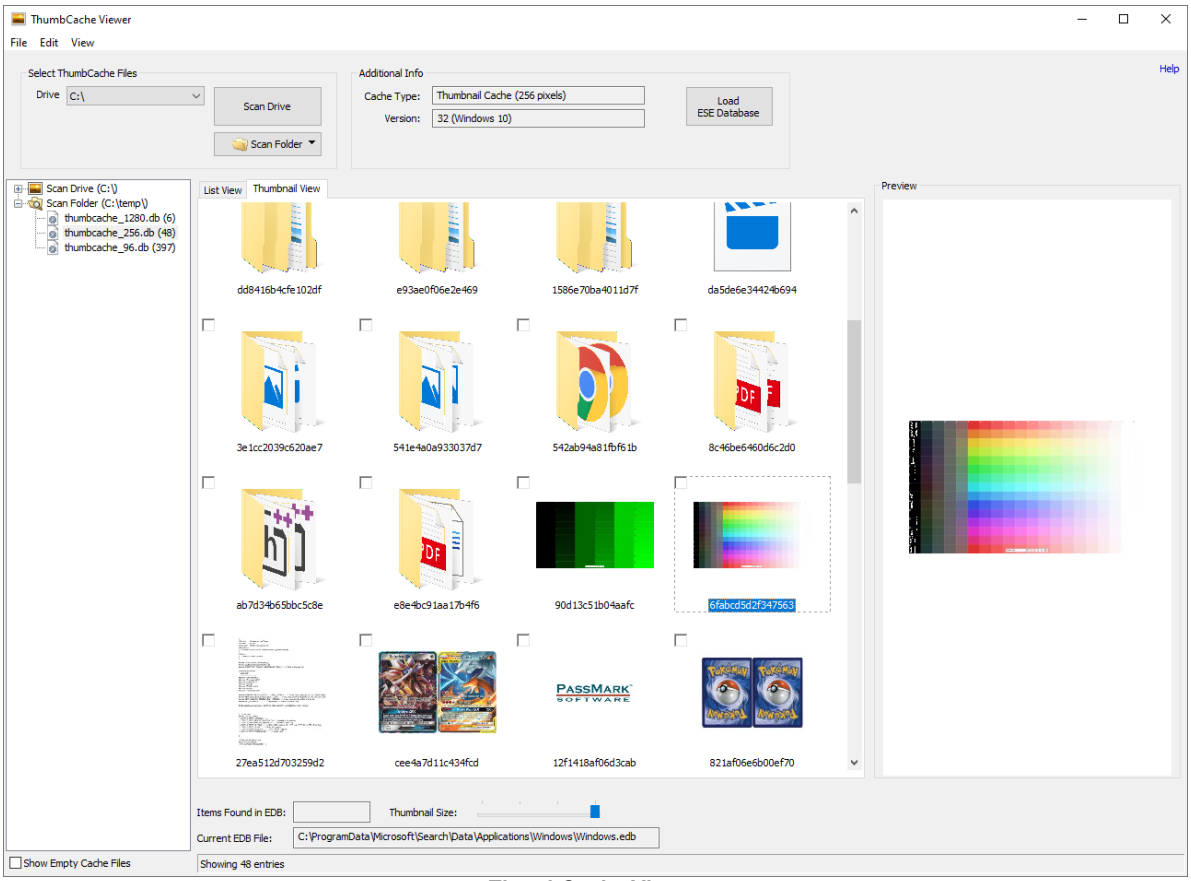


**ThumbCache Viewer**

The table below summarizes the main components of the ThumbCache Viewer

| Component | Description |
|---|---|
| Tree View | Displays the cache database files. |
| List View | Displays a list of thumbnail entries contained in the thumbnail cache file. |
| Thumbnail View | Displays a thumbnail view of the images contained in the thumbnail cache file. |
| Preview Pane | Displays the image of the currently selected thumbnail entry. |

## Usage

To scan thumbnail cache files on Windows Vista and beyond systems, select a Drive from the drop-down list and click 'Scan Drive'. It will search the default thumbnail cache directory **[Drive]:/Users/[User_Name]/AppData/Local/Microsoft/Windows/Explorer** for the cache files listed below.

Icon Cache Files List:

- iconcache_16.db
- iconcache_32.db
- iconcache_48.db
- iconcache_96.db

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- iconcache_256.db
- iconcache_768.db
- iconcache_1280.db
- iconcache_1920.db
- iconcache_2560.db
- iconcache_custom_stream.db
- iconcache_exif.db
- iconcache_idx.db
- iconcache_sr.db
- iconcache_wide.db
- iconcache_wide_alternate.db

Thumbnail Cache Files List:

- thumbcache_16.db
- thumbcache_32.db
- thumbcache_48.db
- thumbcache_96.db
- thumbcache_256.db
- thumbcache_768.db
- thumbcache_1280.db
- thumbcache_1920.db
- thumbcache_2560.db
- thumbcache_custom_stream.db
- thumbcache_exif.db
- thumbcache_idx.db
- thumbcache_sr.db
- thumbcache_wide.db
- thumbcache_wide_alternate.db

In the tree view pane, the iconcache database files are grouped together put under the category "IconCache Files", while thumbcache files listed under "ThumbCache Files". Clicking these two tree view items allows to view all cache entries of iconcache or thumbcache files at once.

ThumbCahe Viewer also supports to load "Thumbs.db" database in the older Windows versions such as Windows 95, 98, ME, 2000, XP and 2003. The files can be added to the tree view by clicking "Add File" or "Scan Folder".

**Load ESE Database**

To view extended information of the cache entries, users need to load the Windows Desktop search file, Windows.edb, which stores additional information for some indexed entries. The Windows.edb file is by default located at:

[Drive]:\ProgramData\Microsoft\Search\ Data\Applications\Windows\

By loading an EDB file, ThumbCache Viewer will search all the records in the **System_ThumbnailCacheId** table of the current Windows.edb database and find out the associated date. Then, they are displayed on the list view, or they can be viewed from the Extended Information dialog.
The mapping is done by searching the matching ThumbCache IDs.

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**List View Columns**

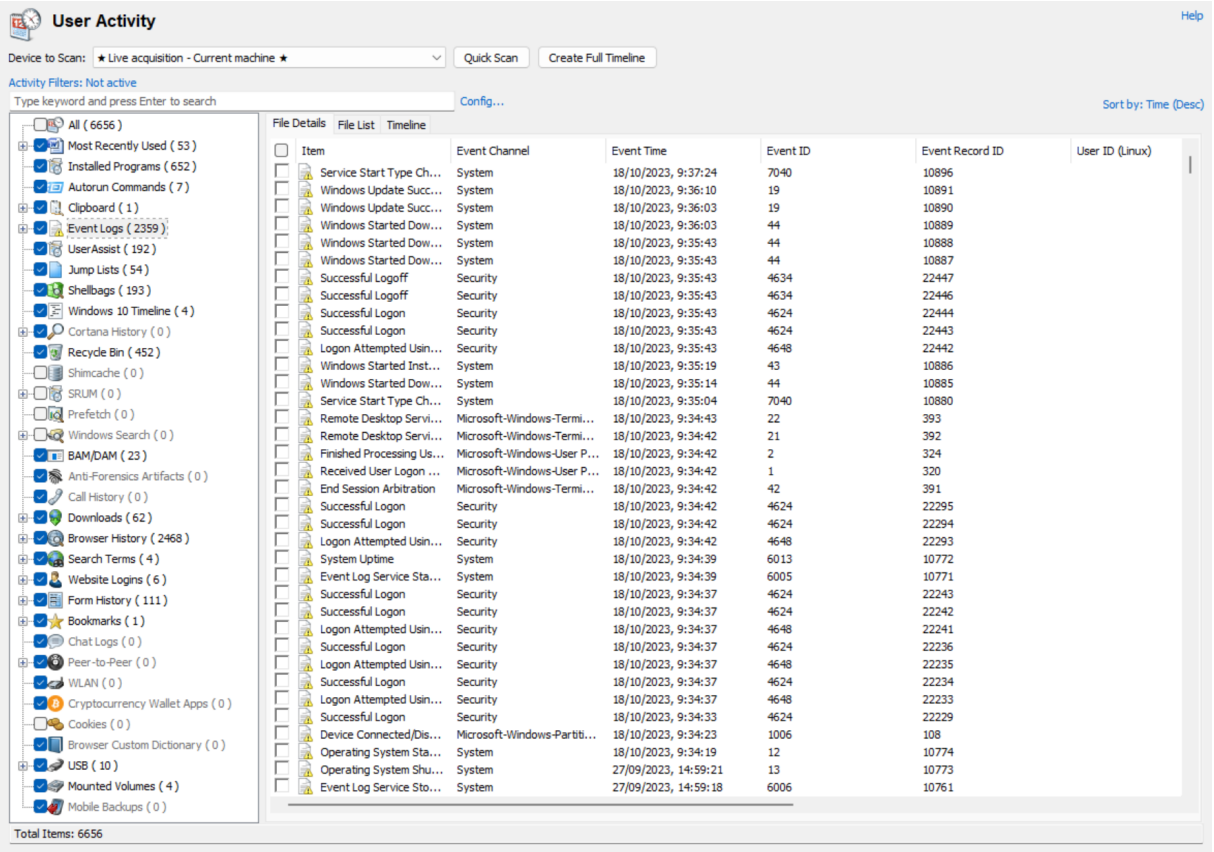
| Column Name | Data Origin | Description |
|---|---|---|
| ThumbCache ID | Cache file | Unique identification string (thumbnail cache ID) made up of sixteen hexadecimal characters. |
| Cache Entry Offset | Cache file | Offset of cache entry in cache file. |
| Cache Entry Size | Cache file | Complete size of cache entry. |
| Data Offset | Cache file | Offset of thumbnail data. |
| Data Size | Cache file | Thumbnail data size. |
| File Name | ESE Database file | Original file name obtained from loaded ESE Database. |
| Item Path Display | ESE Database file | Original file path obtained from loaded ESE Database. |
| Image Size | ESE Database file | Original image dimensions obtained from ESE Database. |
| Date Modified | ESE Database file | Original file modified date and time obtained from ESE Database. |
| Date Photo Taken | ESE Database file | Original file photo taken date and time obtained from ESE Database. |
| Location | | The path of the cache file that the cache entry is retrieved from. |

**Reference List:**


- Morris, S & Chivers, H 2011, An Analysis of the Structure and Behaviour of the Windows 7 Operating System Thumbnail Cache, <http://dspace.lib.cranfield.ac.uk/handle/1826/13547>.
- Quick, D, Tassone, C & Choo, KKR 2014, Forensic Analysis of Windows Thumbcache Files, <https://ssrn.com/abstract=2429795>.
- Morris, SLA 2013, An Investigation into the Identification, Reconstruction, and Evidential Value of Thumbnail Cache File Fragments in Unallocated Space, <http://dspace.lib.cranfield.ac.uk/handle/1826/13547>.


## 5.34 User Activity

The User Activity module scans the system for evidence of user activity, such as accessed websites, installed programs, USB drives, wireless networks, and recent downloads. This is especially useful for identifying trends and patterns of the user, and any material that had been accessed recently.




A scan for user activity can be initiated by simply pressing the Scan button. The following settings are available to the user:

**Device to scan**
Gather the user activity from the live machine or a particular drive. For non-live acquisitions, the scan may not be able to gather as much information as a live acquisition. By default, OSForensics will search for known Windows directories to scan registry files. However, if you have some standalone registry files you can place them in the root directory of a drive (eg a USB thumb drive) and select this drive to be scanned.

> **★ Live acquisition - Current machine ★**
> User activity is gathered from the currently running operating system.

## Quick Scan / Create Full Timeline

Clicking the "Quick Scan" button will run the scan with the currently selected activity types and options. Clicking the "Create Full Timeline" button will enabled all activity types and available options, including those which can take some time to run so the scan will be much slower.

## More Scan Options

By clicking the "Config..." button you will be taken to the User Activity Configuration window where more advanced options can be selected.

## Activity Filters

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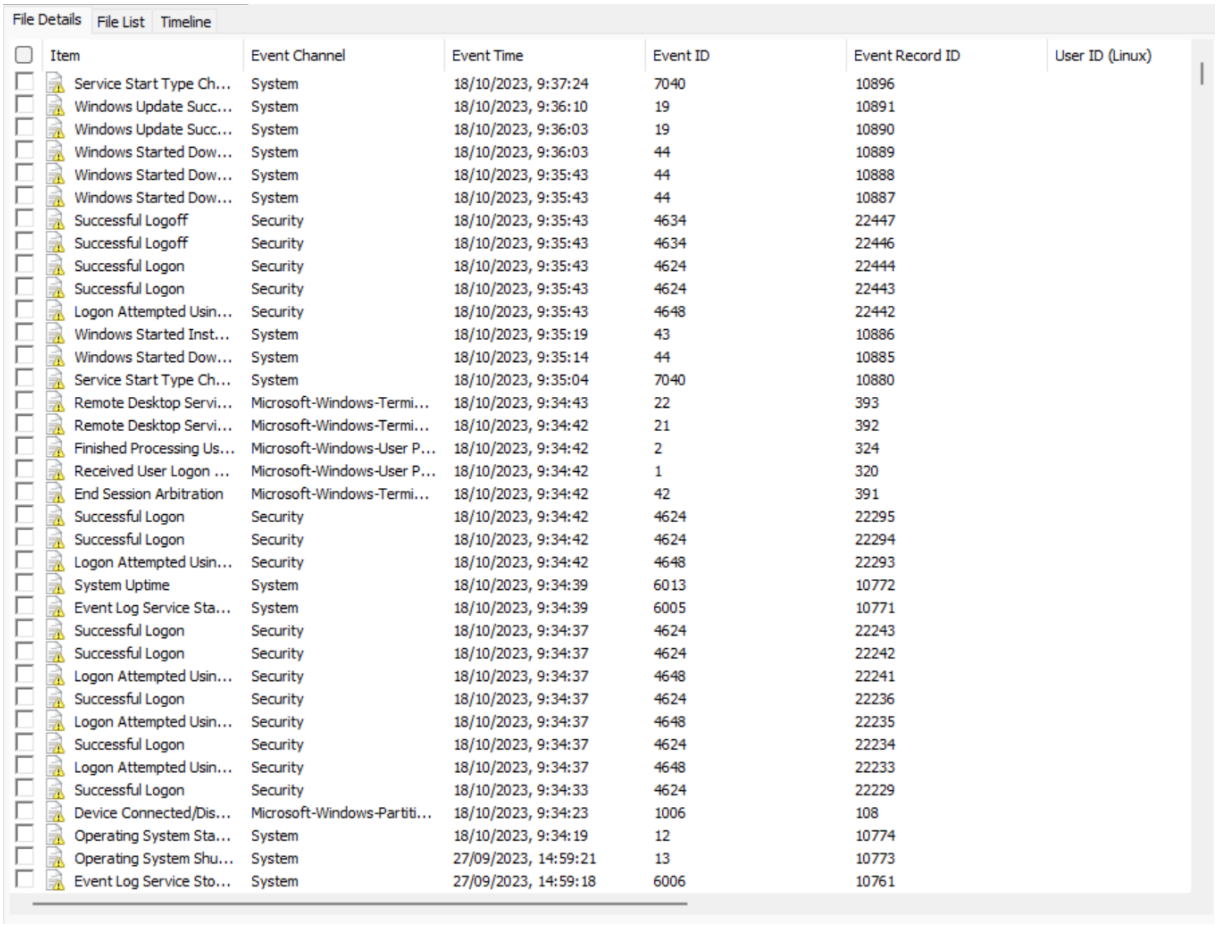
By clicking the *Activity Filters* link, you can configure or clear filter settings. Selecting *Configure...* opens the User Activity Filters window where you can further refine what activity types are displayed.

The search box can also be used to filter results based on text contained in the item description.

## File Details View




| Item | Event Channel | Event Time | Event ID | Event Record ID | User ID (Linux) |
|---|---|---|---|---|---|
| Service Start Type Ch... | System | 18/10/2023, 9:37:24 | 7040 | 10896 | |
| Windows Update Succ... | System | 18/10/2023, 9:36:10 | 19 | 10891 | |
| Windows Update Succ... | System | 18/10/2023, 9:36:03 | 19 | 10890 | |
| Windows Started Dow... | System | 18/10/2023, 9:36:03 | 44 | 10889 | |
| Windows Started Dow... | System | 18/10/2023, 9:35:43 | 44 | 10888 | |
| Windows Started Dow... | System | 18/10/2023, 9:35:43 | 44 | 10887 | |
| Successful Logoff | Security | 18/10/2023, 9:35:43 | 4634 | 22447 | |
| Successful Logoff | Security | 18/10/2023, 9:35:43 | 4634 | 22446 | |
| Successful Logon | Security | 18/10/2023, 9:35:43 | 4624 | 22444 | |
| Successful Logon | Security | 18/10/2023, 9:35:43 | 4624 | 22443 | |
| Logon Attempted Usin... | Security | 18/10/2023, 9:35:43 | 4648 | 22442 | |
| Windows Started Inst... | System | 18/10/2023, 9:35:19 | 43 | 10886 | |
| Windows Started Dow... | System | 18/10/2023, 9:35:14 | 44 | 10885 | |
| Service Start Type Ch... | System | 18/10/2023, 9:35:04 | 7040 | 10880 | |
| Remote Desktop Servi... | Microsoft-Windows-Termi... | 18/10/2023, 9:34:43 | 22 | 393 | |
| Remote Desktop Servi... | Microsoft-Windows-Termi... | 18/10/2023, 9:34:42 | 21 | 392 | |
| Finished Processing Us... | Microsoft-Windows-User P... | 18/10/2023, 9:34:42 | 2 | 324 | |
| Received User Logon ... | Microsoft-Windows-User P... | 18/10/2023, 9:34:42 | 1 | 320 | |
| End Session Arbitration | Microsoft-Windows-Termi... | 18/10/2023, 9:34:42 | 42 | 391 | |
| Successful Logon | Security | 18/10/2023, 9:34:42 | 4624 | 22295 | |
| Successful Logon | Security | 18/10/2023, 9:34:42 | 4624 | 22294 | |
| Logon Attempted Usin... | Security | 18/10/2023, 9:34:42 | 4648 | 22293 | |
| System Uptime | System | 18/10/2023, 9:34:39 | 6013 | 10772 | |
| Event Log Service Sta... | System | 18/10/2023, 9:34:39 | 6005 | 10771 | |
| Successful Logon | Security | 18/10/2023, 9:34:37 | 4624 | 22243 | |
| Successful Logon | Security | 18/10/2023, 9:34:37 | 4624 | 22242 | |
| Logon Attempted Usin... | Security | 18/10/2023, 9:34:37 | 4648 | 22241 | |
| Successful Logon | Security | 18/10/2023, 9:34:37 | 4624 | 22236 | |
| Logon Attempted Usin... | Security | 18/10/2023, 9:34:37 | 4648 | 22235 | |
| Successful Logon | Security | 18/10/2023, 9:34:37 | 4624 | 22234 | |
| Logon Attempted Usin... | Security | 18/10/2023, 9:34:37 | 4648 | 22233 | |
| Successful Logon | Security | 18/10/2023, 9:34:33 | 4624 | 22229 | |
| Device Connected/Dis... | Microsoft-Windows-Partiti... | 18/10/2023, 9:34:23 | 1006 | 108 | |
| Operating System Sta... | System | 18/10/2023, 9:34:19 | 12 | 10774 | |
| Operating System Shu... | System | 27/09/2023, 14:59:21 | 13 | 10773 | |
| Event Log Service Sto... | System | 27/09/2023, 14:59:18 | 6006 | 10761 | |

The File Details View displays the same user activity of the system as the File List View except presented in a table format. This view is useful for quickly identifying, locating and sorting activities of interest. Each entry is coded by the type of activity and can be identified by the icon displayed at the beginning of the row.

## Timeline View

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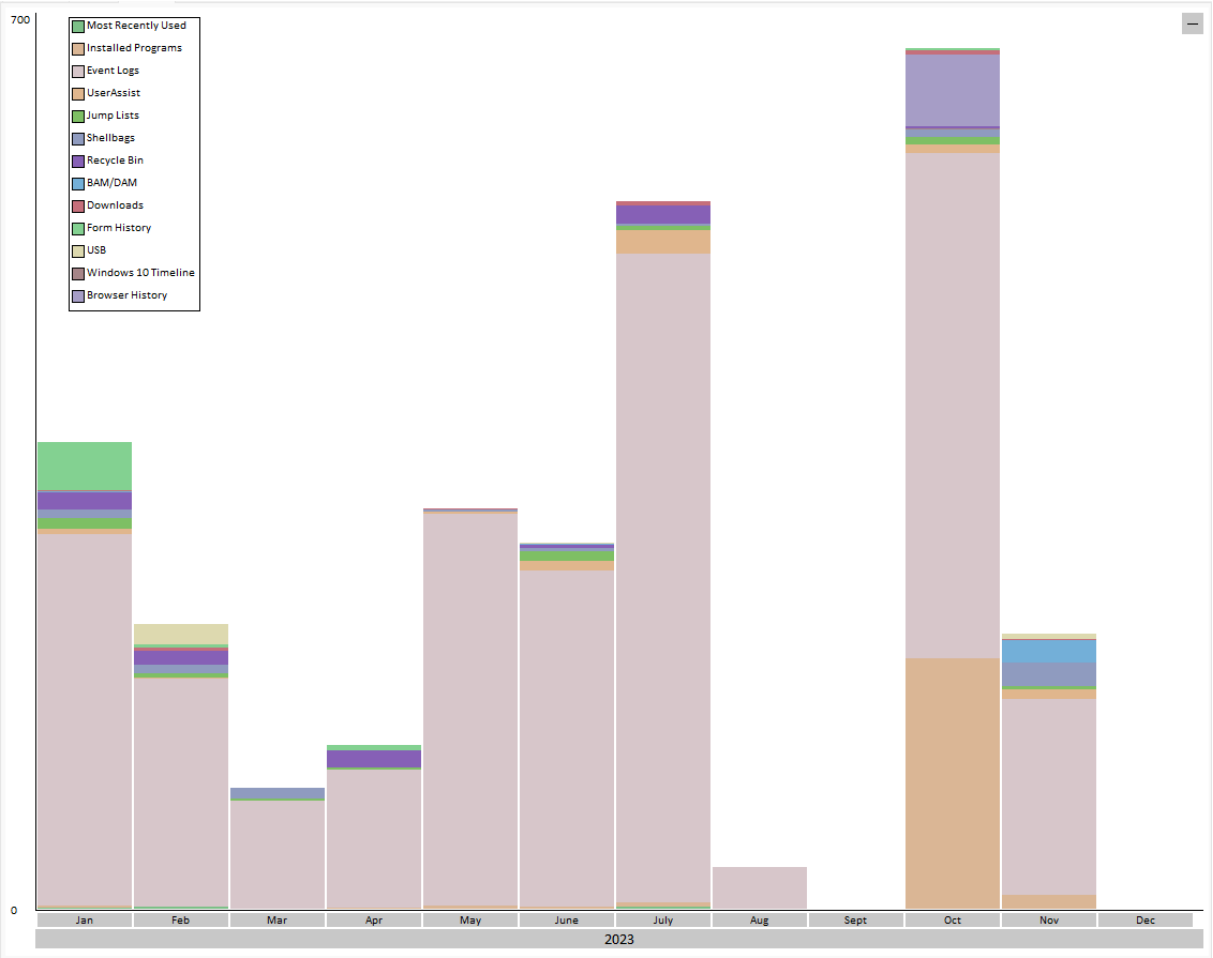
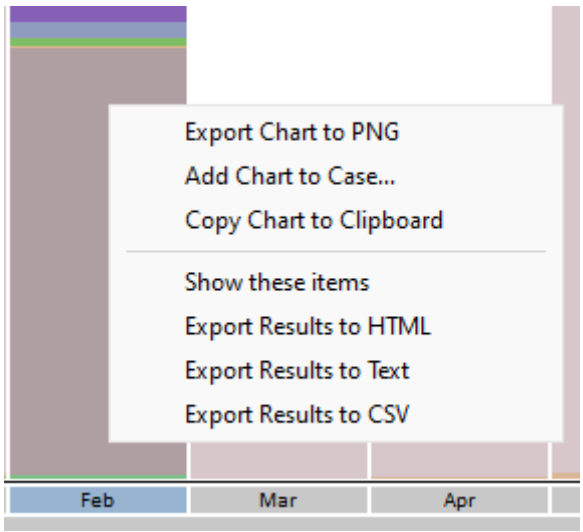



The Timeline View displays an interactive bar graph providing the user with a time-based view of user activity on the system. This view is useful for identifying trends where significant activity has occurred. Each bar is colour-coded by the type of activity. Right-clicking a bar section brings up the following menu:

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**Show these files**
Filter the results according to the corresponding activity type and date/time

**Export to HTML**
Export the results contained in the highlighted bar to HTML

**Export to Text**
Export the results contained in the highlighted bar to text

**Export to CSV**
Export the results contained in the highlighted bar to CSV

### Additional Information

See the following pages for more detailed information about the specifics of some of the data gathering.
Registry Activity
Windows Event Log
Windows Jump Lists
Windows Search
Chat Logs
Peer-2-Peer
Windows Prefetch
OSX Activity
SRUM Database
Clipboard Activity

## 5.34.1 User Activity Configuration

The User Activity Configuration Window allows the user to configure the User Activity scan options. This window can be accessed by clicking on the "Config..." button in the main User Activity window.

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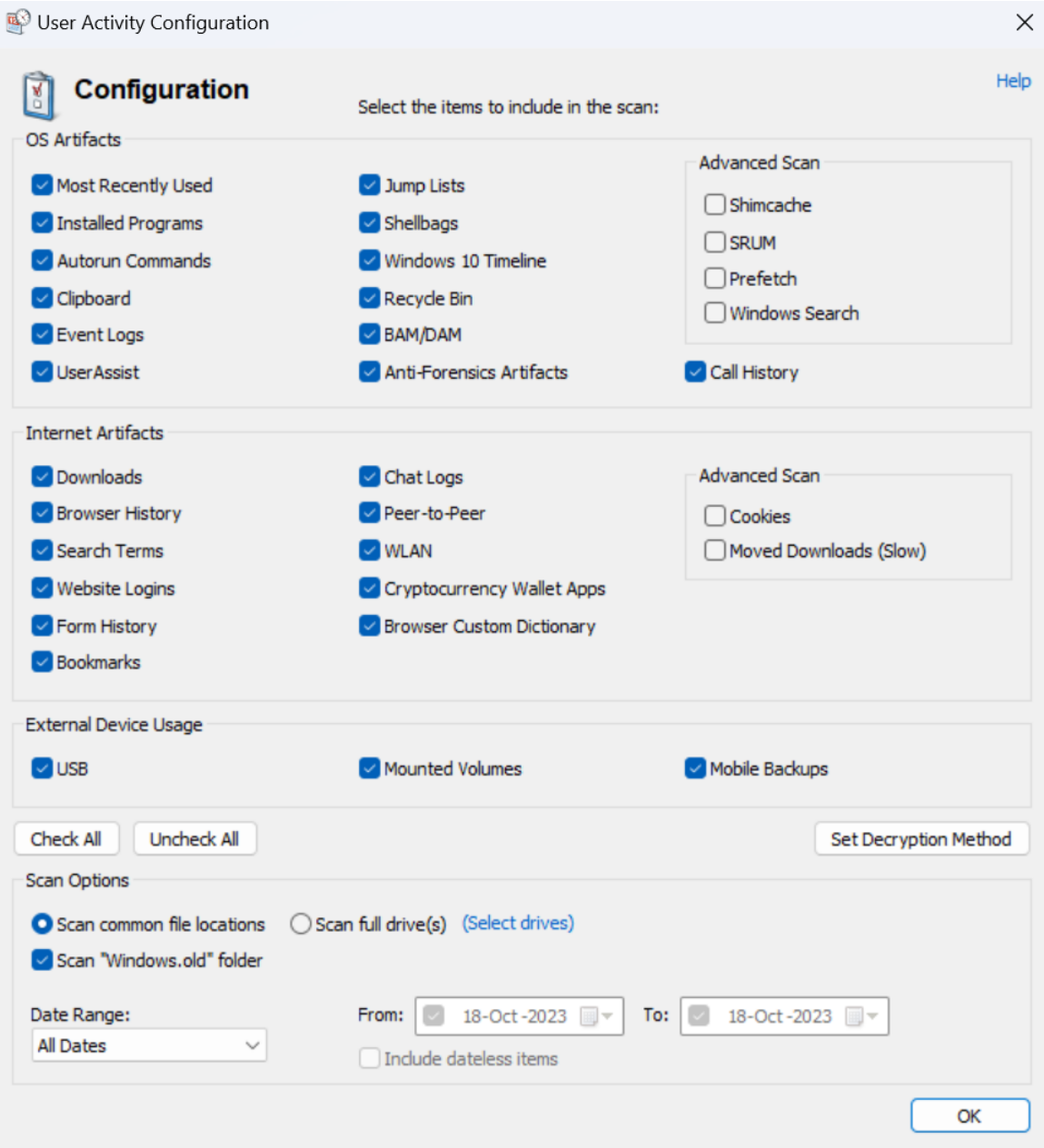


## OS Artifacts

| Item | Enabled by Default? | Description |
|---|---|---|
| Most Recently Used (MRU) | Yes | See Registry Activity for more details. |
| Installed Programs | Yes | See Registry Activity for more details. |
| Autorun Commands | Yes | See Registry Activity for more details. |
| Clipboard | Yes | - |
| Event Logs | Yes | See Event Logs for more details. |
| UserAssist | Yes | See Registry Activity for more details. |

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| Item | Enabled by Default? | Description |
|---|---|---|
| Jump Lists | Yes | See Jump Lists for more details. |
| Shellbags | Yes | See Shellbags for more details. |
| Windows 10 Timeline | Yes | - |
| Cortana History | Yes | See Cortana History for more details. |
| Recycle Bin | Yes | - |
| Shimcache | No | - |
| SRUM | No | - |
| Prefetch | No | See Prefetch Viewer for more details. |
| Windows Search | No | See Windows Search for more details. |
| BAM/DAM | Yes | See BAM/DAM for more details. |
| Anti-Forensics Artifacts | Yes | See Anti-Forensics Artifacts for more details. |
| Call History | Yes | (OSX only) Enables scanning for calls from the CallHistory.storedata file. |

**Internet Artifacts**

| Item | Enabled by Default? | Description |
|---|---|---|
| Downloads | Yes | - |
| Browser History | Yes | - |
| Search Terms | Yes | - |
| Website Logins | Yes | - |
| Form History | Yes | - |
| Bookmarks | Yes | - |
| Chat Logs | Yes | Enables scanning for chat logs from MSN Messenger, AIM, Yahoo Messenger, ICQ, Skype, Miranda IM, and Pidgin. |
| Peer-to-Peer | Yes | Enables scanning for artifacts from BitTorrent/uTorrent resume.dat file and .torrent files in the user's download folder. Artifacts from Ares Galaxy ShareH.dat file are retrieved. Emule known.met, server.met, StoredSearches.met and cancelled.met files. Will look for files with .nzb extension in the download folder along with installation of popular UseNet program SABnzbd. Also, registry search information from Shareaza. Additional results may be obtained from running the Peer-2-Peer preset from File Name Search. |
| WLAN | Yes | See Registry Activity for more details. |
| Cryptocurrency Wallet Apps | Yes | See Cryptocurrency Wallet Apps for more details. |
| Cookies | No | - |
| Moved Downloads (Slow) | No | Scan the selected drive for files that have been downloaded and then moved from the download folder (using Zone.Identifier stream information). This can only be run on drives/images that use NTFS.<br>As this process can be very slow this option is disabled by default. If the downloads option is selected via the treeview control on the user activity page this option is not enabled |

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| Item | Enabled by Default? | Description |
|---|---|---|
| | | automatically and can only be enabled from the configuration dialog. |

**External Device Usage**

| Item | Enabled by Default? | Description |
|---|---|---|
| USB | Yes | See Registry Activity for more details. |
| Mounted Volumes | Yes | See Registry Activity for more details. |
| Mobile Backups | Yes | Scanning for iOS backups that may have been stored on the system. |

**Scan Common File Locations / Scan Full Drives**
The common file locations will be scanned by default.
If the Scan Full Drives option is checked, OSForensics will perform a full drive scan across the selected drives to search for the artifacts.

**Search date ranges only**
Allows the user to specify a particular access date range for the search results.

**Include dateless items**
If checked, will include items without an access date.

## 5.34.2 User Activity Filters

The User Activity Filters Window allows the user to add filters to narrow down the results from a User Activity scan. This window can be accessed by clicking on the *Configure...* option in the *Activity Filters* link drop-down menu in the main User Activity window.

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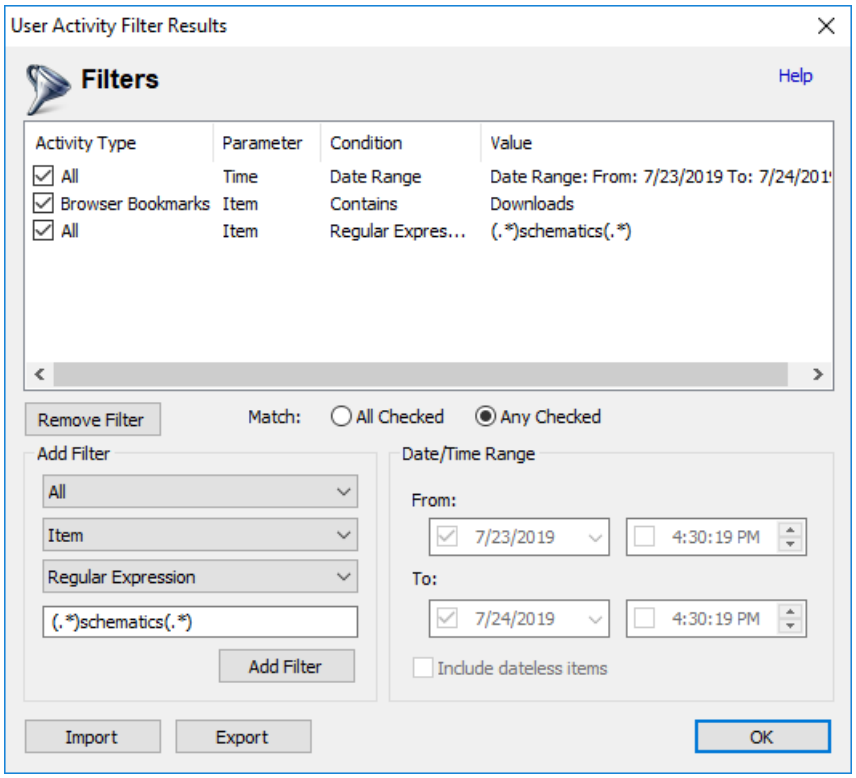


The top list will show which filters have been added and which are enabled. Filters with the check mark will be **enabled**. To temporarily disable a filter you can uncheck the item in the list. To no longer have the filter available, you can use the **Remove Filter** button.

**About Filters**
There are two types of filters: one that affects all activity types and ones that are activity type specific. If the "Activity Type" is set to "All", it will be applied to all activities. If the filter is set to a specific type, e.g. "Browser History", then the filter will only be used to filter those activity types.

**Match:**
If set to "All Checked", then for the activity to be displayed in the list it must match every enabled "All" filters and every enabled activity specific filters for its type. If set to "Any Checked" then for the activity to be displayed in the list it must match at least one of the enabled "All" filters or one of the enabled activity specific filters for its type.

**Import & Export**
These buttons let you save and load existing filters for future use.

## Adding Filters

There are three drop down boxes.The top dropdown box is for the Activity Type and will contain the available activity type filters and an All type. The second dropdown box is the Parameter to filter for that activity. The third dropdown is the condition upon which to match. Depending on your selection, the Parameter and Condition dropdowns will be auto-populated to aid you in adding filter. Depending on the Parameter type you will be given different conditions to use. Parameter types are:

| Equal (=) | Not Equal (!=) | Less Than (<) | Less Than or Equal (<=) | Greater Than (>) | Greater Than or Equal | Contains | Regular Expression | Date Range |
|---|---|---|---|---|---|---|---|---|

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| | | | | | | (>=) | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Text** | Yes | Yes | No | No | No | No | Yes | Yes | No |
| **Number** | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No |
| **Date** | Yes | Yes | No | No | No | No | No | No | Yes |
| **User** | Yes | Yes | No | No | No | No | No | Yes | No |
| **Choice** | Yes | Yes | No | No | No | No | No | No | No |
| **Filesize** | No | No | Yes | Yes | Yes | Yes | No | No | No |

**Equal -** For text, the string must match exactly (case insensitive). For Number the number must match exactly. For Date, the day must match. For Choice the selected choice must equal.
**Not Equal -** See "Equal" above, except in this case it must not match.
**Less Than -** For number and file size, must be less than this number or size.
**Less Than or Equal -** For number and file size, must be less than or equal to this number or size.
**Greater Than -** For number and file size, must be greater than this number or size.
**Greater Than or Equal -** For number and file size, must be greater than or equal to this number or size.
**Contains -** For text only. The text must contain this string (case insensitive).
**Regular Expression -** Case insensitive. See Regular Expressions for more details.
**Date Range -** Date must be within these dates. If "Include dateless items" is checked, then any activity without a proper date will be a match.

### 5.34.3 OSX Activity

OSForensics User Activity module will scan for OSX specific artifacts if it detects that the drive to be searched is formatted as a HFS or APFS file-system.

**Most Recently Used -** Search for recently accessed applications, items, documents, media and network connections in various property list (.plist) and shared file list (.sfl2) files.
**Installed Programs -** List the applications found in the Applications directory and sub-directories.
**Autorun Commands -** Search for log in activity items.
**Event Logs -** Parse logs for Shutdown and CD/DVD disc burning events. Also parse KnowledgeC.db.
**Recycle Bin -** Show deleted files in bin, and their original paths.
**Call History -** Lists calls found in the CallHistory.storedata file.
**WiFi -** Show previous WiFi connections.
**USB -** List connection of iOS devices.
**Mounted Volumes**
**Mobile Backups** - List backups from iOS devices.

In addition to the OSX specific artifacts, browser artifacts from Safari, Chrome and Firefox are searched for. Including History, Bookmark, Download and Cookie data.

Certain words recorded for auto-correction and predictive text features are also scanned (currently saved under the Form History category).

### 5.34.4 Registry Activity

By default OSForensics will search for known Windows directories to scan for registry files, however if you have some standalone registry files you can place them in the root directory of a drive (eg a USB thumb drive at G:) and select this drive to be scanned. OSForensics will scan the following registry files for recent activity:

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- SYSTEM
- NTUSER.dat

## Most Recently Used Lists (MRU)

OSForensics checks several known registry locations that store MRU data, this includes locations for Microsoft Office, Microsoft Wordpad, Microsoft Paint, Microsoft Media Player, Windows search, recent documents, connected network drives and the Windows Run command. In addition, OSF will also check the user's Recent Items directory. The Recent Items access is very useful to view the recently opened files from a local computer or network location. [1]

| | |
|---|---|
| MS Office - Recent Docs | Searches known registry keys for Microsoft Office MRU Documents for Office versions: 9.0, 11.0, 12.0, 14.0, 15.0, 16.0 and |
| Windows - 'Run' Entry | Software\Microsoft\Windows\CurrentVersion\Explorer\RunMRU |
| Windows - Mapped Network Drives | • Software\Microsoft\Windows\CurrentVersion\Explorer\Map Network Drive MRU<br>• Network |
| Windows - Search History | • Software\Microsoft\Search Assistant\ACMru\5603<br>• Software\Microsoft\Windows\CurrentVersion\Explorer\WordWheelQuery |
| Windows XP - Media Search History | Software\Microsoft\Search Assistant\ACMru\5604 |
| Windows XP - Internet Search Assistant | Software\Microsoft\Search Assistant\ACMru\5001 |
| Windows XP - People, Computer, Printers | Software\Microsoft\Search Assistant\ACMru\5647 |
| Wordpad - Recent Docs | Software\Microsoft\Windows\CurrentVersion\Applets\Wordpad\Recent File List |
| MS Paint - Recent Files | Software\Microsoft\Windows\CurrentVersion\Applets\Paint\Recent File List |
| Media Player - Recent Files | • Registry Locations:<br>  ○ Software\Microsoft\MediaPlayer\Player\RecentFileList<br>  ○ Software\Microsoft\MediaPlayer\Player\RecentURLList<br>• Disk Locations:<br>  ○ VLC (vlc-qt-interface.ini on Windows or vlc-qt-interface.conf on Linux)<br>  ○ WMP (lastplayed.wpl and wmpfolders.wmdb) |
| Windows - Recent Documents | Software\Microsoft\Windows\CurrentVersion\Explorer\RecentDocs |
| Adobe Reader - Recent Files | Searches known registry keys for Adobe Reader MRU for versions: 9.0, 10.0, 11.0, DC |
| Windows Explorer - Last Visist | • Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedMRU<br>• Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\LastVisitedPidlMRU |
| Windows Explorer - Open/Save | • Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSaveMRU<br>• Software\Microsoft\Windows\CurrentVersion\Explorer\ComDlg32\OpenSavePidlMRU |
| Windows Explorer - Resent Items | Disk Location: <user>\AppData\Roaming\Microsoft\Windows\Recent |
| OSX - ... | See OSX Activity |

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## AutoRun Entrires
Programs that are run automatically when Windows starts or a user log in are retrieved from the registry,

## Mounted Volumes
Volume IDs are collected from the system registry and matched to the and drive letters they were associated with.

## Installed Programs
Programs that have been installed are retrieved from the system and user registry files
Dates are read from the 'InstallDate' value where available and where this doesn't exist the last write date of the registry key where the information is located is used.

## Connected USB devices
USB devices that have been connected to the computer, this includes USB memory sticks, portable hard drives and other external USB devices like CD-Rom drives. A manufacturer name, product ID, serial number and the last connection date should be displayed for each device.

## Wireless Network Connections (WLAN)
The MAC address of any wireless networks connected to using the Windows Zero Config service (default Windows wireless connection manager) **(Windows XP only). On Vista and newer** the registry and known locations on disk are checked for XML profiles of networks. The Creation/Modified dates represent the file times of the XML profile, or if it was purely a registry entry the last key write time.

## UserAssist Entrys
The UserAssist key from the registry contains programs and links that are opened frequently.

## Shellbag entries
Shellbag entries are recovered from the user specific registry files NTUSER.DAT and USRCLASS.DAT. OSForensics will attempt to recover dates and names of items where available. Currently more information will be exported into CSV format than is displayed due to screen limitations. Items that are identified only by a GUID will attempt to be named using a lookup list with the GUID appended to the name in '{ }'.

[1]The Recent Items folder (previously called Recent Documents in Windows XP) is used by Windows to record what documents have been opened (the default location is typically is "C:\Users\%UserName%\AppData\Roaming\Microsoft\Windows\Recent"). The files in this directory are actually shortcut (.lnk) files. As these are shortcuts, they may no longer work if the file have been moved or deleted since it was originally created. Also of note, is when using "Scan Drive" option and choosing an added OSForensics' device, links may point to local and network locations that may not be available on the current machine.

### 5.34.5 Event Logs

Windows Event Logs record the various events occur on the system which are of interest to forensic investigators.
User Activity Event Logs scan the logs created by Windows Vista and beyond. It supports event logs with file extension .evtx located in the **%System32%\winevt\Logs** directory.
You could use the OSForensics built-in Event Log Viewer module to perform advanced scan and filtering operations.

The following Event IDs are included in the User Activity scan:

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### Logon/Logoff

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| Microsoft-Windows-User Profile Service%4Operational.evtx | | | |
| 1 | Received User Logon Notification | EventData / Session | [1] |
| 2 | Finished Processing User Logon Notification | EventData / Session | [1] |
| 3 | Received User Logoff Notification | EventData / Session | [1] |
| 4 | Finished Processing User Logoff Notification | EventData / Session | [1] |
| Security.evtx | | | |
| 4624 | Successful Logon<br><br>**(Logon type 5 is excluded due to the overwhelming amount of these events generated by Windows)** | EventData / TargetUserName<br>EventData / TargetDomainName<br>EventData / TargetLogonId<br>EventData / LogonType<br>EventData / WorkstationName<br>EventData / IpAddress | [2]<br>[3] |
| 4634 | Successful Logoff | EventData / TargetUserName<br>EventData / TargetDomainName<br>EventData / TargetLogonId<br>EventData / LogonType | [2]<br>[3] |
| 4647 | User Initiated Logoff | EventData / TargetUserName<br>EventData / TargetDomainName<br>EventData / TargetLogonId | [3] |
| 4648 | Logon Attempted Using Explicit Credentials | EventData / SubjectUserName<br>EventData / SubjectDomainName<br>EventData / SubjectLogonId<br>EventData / TargetUserName<br>EventData / IpAddress | [1]<br>[3] |
| 4625 | Failed Logon Attempts | EventData / TargetUserName<br>EventData / TargetDomainName<br>EventData / FailureReason<br>EventData / LogonType<br>EventData / WorkstationName<br>EventData / IpAddress | [2]<br>[3] |
| 4740 | User Account Locked Out | EventData / TargetUserName<br>EventData / TargetDomainName | [2] |
| 4767 | User Account Unlocked | EventData / TargetUserName<br>EventData / TargetDomainName | [2] |
| 4776 | Successful/Failed NTLM Authentication | EventData / TargetUserName<br>EventData / Workstation<br>EventData / Status | [2]<br>[3] |

### Storage Devices Usage

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| System.evtx | | | |
| 10000 | Installing/Updating Device Driver | UserData / DeviceId | [1] |
| 20001 | Driver Installation Completed | UserData / DeviceInstanceID<br>UserData / DriverDescription | [1] |
| 20003 | Service Addition Process Completed | UserData / DeviceInstanceID | [1] |

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| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| Microsoft-Windows-DriverFrameworks-UserMode%4Operational.evtx | | | |
| 2003 | UMDF Host Process is Requested to Load Drivers for Device | UserData / InstanceId | [1] |
| 2101 | Pnp or Power Operation Completed for Device | UserData / InstanceId | [1] |
| 2102 | Finished Pnp or Power Operation Forwarded for Device | UserData / InstanceId | [1] |
| 1006 | Device Connected/Disconnected | EventData / DiskNumber<br>EventData / Manufacturer<br>EventData / Model<br>EventData / Revision<br>EventData / SerialNumber<br>EventData / DiskId<br>EventData / BusType<br>EventData / PartitionStyle<br>EventData / PartitionCount<br>EventData / PartitionTableBytes | |

**Application Install**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| Microsoft-Windows-Application-Experience%4Program-Compatibility-Assistant.evtx | | | |
| 17 | Application Installation EXE Path | UserData / ExePath | [1] |
| Application.evtx | | | |
| 11707 | Software Package Installation Success | EventData / Data | [4] |
| 11708 | Software Package Installation Failure | EventData / Data | [4] |
| 11724 | Software Package Removal Success | EventData / Data | |

**Windows Services**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| System.evtx | | | |
| 7034 | Service Terminated Unexpectedly | EventData / param1<br>EventData / param2 | [3] |
| 7035 | Service Stop/Start Control Sent | - | [2]<br>[3] |
| 7036 | Service Status Changed | EventData / param1<br>EventData / param2 | [2]<br>[3] |
| 7040 | Service Start Type Changed | EventData / param1<br>EventData / param2<br>EventData / param3 | [3] |
| 7045 | Service Installed | EventData / ServiceName<br>EventData / ImagePath<br>EventData / ServiceType<br>EventData / StartType<br>EventData / AccountName | [3] |

**Windows Update**

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| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| System.evtx | | | |
| 19 | Windows Update Success | EventData / updateTitle | [5] |
| 20 | Windows Update Failure | EventData / errorCode<br>EventData / updateTitle | |
| 43 | Windows Started Installing Update | EventData / updateTitle | |
| 44 | Windows Started Downloading Update | EventData / updateTitle | |

**Microsoft Office Usage**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| OAlerts.evtx | | | |
| 300 | Microsoft Office Alert | EventData / Data | [1] |

**System Start/Shutdown**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| System.evtx | | | |
| 12 | Operating System Started At | EventData / StartTime | [1] |
| 13 | Operating System Shutting Down At | EventData / StopTime | [1] |
| 1074 | Process Initialted Power Off/Restart | EventData / param1<br>EventData / param2<br>EventData / param3<br>EventData / param4<br>EventData / param5<br>EventData / param7 | [1] |
| 6005 | Event Log Service Started | - | |
| 6006 | Event Log Service Stopped | - | |
| 6013 | System Uptime | EventData / Data | [1] |

**Remote Access**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| Microsoft-Windows-TerminalServices-RDPClient%4Operational.evtx | | | |
| 1102 | Client Initiated a Multi-transport Connection to Server | EventData / Name<br>EventData / Value | [1] |
| 1105 | Multi-transport Connection Disconnected | | [1] |
| 1024 | RDP ClientActiveX is Trying to Connect to Server | EventData / Name<br>EventData / Value | [1] |
| 1026 | RDP ClientActiveX Disconnected | EventData / Name<br>EventData / Value | [1] |
| 1027 | Connected to Domain | EventData / DomainName<br>EventData / SessionId | [1] |
| Security.evtx | | | |
| 4778 | Session Reconnected to Window Station | EventData / AccountName<br>EventData / AccountDomain | [6] |

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| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| | | EventData / LogonID<br>EventData / SessionName<br>EventData / ClientName<br>EventData / ClientAddress | |
| 4779 | Session Disconnected from Window Station | EventData / AccountName<br>EventData / AccountDomain<br>EventData / LogonID<br>EventData / SessionName<br>EventData / ClientName<br>EventData / ClientAddress | [6] |
| Microsoft-Windows-TerminalServices-RemoteConnectionManager%4Operational.evtx | | | |
| 261 | Listener Received a Connection | UserData / listenerName | [1] |
| 1149 | Remote Desktop Services: User Authentication Succeeded | UserData / Param1<br>UserData / Param2<br>UserData / Param3 | [1]<br>[6] |
| Microsoft-Windows-TerminalServices-LocalSessionManager%4Operational.evtx | | | |
| 21 | Remote Desktop Services: Session Logon Succeeded | UserData / User<br>UserData / SessionID<br>UserData / Address | [6] |
| 22 | Remote Desktop Services: Shell Start Notification Received | UserData / User<br>UserData / SessionID<br>UserData / Address | [6] |
| 24 | Remote Desktop Services: Session Disconnected | UserData / User<br>UserData / SessionID<br>UserData / Address | [1]<br>[6] |
| 25 | Remote Desktop Services: Session Reconnection Succeeded | UserData / User<br>UserData / SessionID<br>UserData / Address | [1]<br>[6] |
| 42 | End Session Arbitration | UserData / User<br>UserData / SessionID | [1] |
| Microsoft-Windows-SmbClient%4Connectivity.evtx | | | |
| 30804 | Client's Connection to Server Disconnected | EventData / ServerName<br>EventData / Address | [1] |
| 30805 | Client Lost Session to Server | EventData / SessionId<br>EventData / ServerName | [1] |
| 30806 | Client Re-established Session to Server | EventData / SessionId<br>EventData / ServerName<br>EventData / Address | [1] |
| 30807 | Connection to Share Lost | EventData / SessionId<br>EventData / ServerName | [1] |
| 30808 | Connection to Share Re-established | EventData / SessionId<br>EventData / ServerName<br>EventData / Address | [1] |

**Printer Usage**

| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| Microsoft-Windows-PrintService%4Operational.evtx | | | |

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| Event ID | Description (Item column) | Event Schema Element / Data Item | Reference |
|---|---|---|---|
| 307 | Document Printed | UserData / Param1<br>UserData / Param2<br>UserData / Param3<br>UserData / Param4<br>UserData / Param5<br>UserData / Param7<br>UserData / Param8 | [1] |
| 801 | Printing Job | UserData / JobId | [1] |
| 802 | Deleting Job | UserData / JobId<br>UserData / JobSize<br>UserData / Pages | [1] |
| 842 | Print Job Sent to Printer | UserData / JobId<br>UserData / Printer | [1] |

**List View Columns**

| Column Name | Data Origin |
|---|---|
| Item | See the Description in the above tables |
| Event Channel | Channel property of the System section |
| Event Time | TimeCreated property of the System section |
| Event ID | EventID property of the System section |
| Event Record ID | EventRecordID property of the System section |
| Event ID (Linux) | - |
| Event Information | See the Event Schema Element / Data Item in the above tables |
| User | EventData / SubjectUserName<br>EventData / TargetUserName |

**Reference List:**

[1] Kang, S, Kim, S, Park, M & Kim, J 2018, Study on Windows Event Log-Based Corporate Security Audit and Malware Detection, <https://doi.org/10.13089/JKIISC.2018.28.3.591>.
[2] Anson, S, Bunting, S, Johnson, R & Pearson, S 2012, Mastering Windows Network Forensics and Investigation, 2nd edn, John Wiley & Sons, United States of America.
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[4] Microsoft 2018, 'Event Logging', <https://docs.microsoft.com/en-us/windows/win32/msi/event-logging>.
[5] Do, Q, Martini, B, Looi, J, Wang, Y & Choo KK 2014, Windows Event Forensic Process, <https://doi.org/10.1007/978-3-662-44952-3_7>.
[6] Poling, J 2018, 'Windows RDP-Related Event Logs: Identification, Tracking, and Investigation', <https://ponderthebits.com/2018/02/windows-rdp-related-event-logs-identification-tracking-and-investigation/>.

## 5.34.6 Jump Lists

Jumps lists are a feature introduced to Windows 7 that allow fast access to programs and favorites as well as functioning as a most recently used list for some programs (see the Micorosoft page on jump lists for more information on how they function.

Jump lists come in two formats, automatic which are created by Windows and custom which are created when a user interacts with the program such as pinning an item to the list. OSForensics is

currently retrieving information from the "Destlist" section of the automatic jump lists and all the entries from the custom jump lists.

The information presented by OSForensics includes;

- filename, path and any command line arguments stored (where available)
- system name (where available)
- the item ID (where the item appears in the jump list file
- last access date
- location of jumplist file item was retrieved from

### 5.34.7 Shellbags

Shellbag entries keep a record of size, position, icon and views of a folder when accessed via Windows Explorer. This information can be used to see what folders have been accessed in Explorer.

The information presented by OSForensics includes;

- Folder name and disk path
- Location in the registry file (registry bag path) entry was retrieved from
- last access date of folder
- creation and modified date for the entry in the registry file

### 5.34.8 SRUM

OSForensics will scan for the system resource usage monitor database in the Windows\System32\sru\ folder.
If found it will read information from these parts of the database;

- Windows network data usage monitor table {973F5D5C-1D90-4944-BE8E-24B94231A174}
- Application resource usage table {D10CA2FE-6FCF-4F6D-848E-B2E99266FA89}
- Windows network connectivity usage monitor table {DD6636C4-8929-4683-974E-22C046A43763}
- Windows push notification table {D10CA2FE-6FCF-4F6D-848E-B2E99266FA86}

An attempt will be made to convert the User-SID's present in the table to user names (where available).

### 5.34.9 Prefetch

The Prefetcher is an operating system component that improves the performance of the system by pre-caching applications and its associated files into RAM, reducing disk access. In order to determine the applications that are used most frequently, the Prefetcher collects application usage details such as the number of times the application has been executed, the last run time, and any files that the application uses when it is running.

In a forensics point of view, application usage patterns (eg. "Cleaner" software used recently) and files that have been opened (eg. documents) recently can be uncovered.

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### 5.34.10 Windows Search

Windows Search is a desktop indexer that has been integrated and enabled by default in Windows operating systems since Vista. Windows (Desktop) Search can also be optionally installed on Windows XP and Windows 2003. During its normal operating, Window Search runs in the background, creating a full-text index of the files on the computer. This index allows for fast searching of filenames and file contents matching the specified search term.

In a forensics point of view, the index database can contain valuable artifacts that an be useful for mapping user activity during any given time frame. In particular, a forensics investigator can obtain valuable forensics information from the analysis of the index database, such as:

- File activity at any given point in time (such as installed programs and modified documents)
- Files contained in disks that are damaged or no longer exist (such as external disks)
- Plain text data from indexed files such as documents and e-mails
- Plain text data from encrypted files

Because Windows Search is enabled by default, the index database acts as a digital footprint of the system activity. The typical user is likely to be unaware of the indexing operation taking place in the background.

### 5.34.11 Cortana History

Cortana is a digital personal assistance present on Windows computers after Windows 10. Cortana acts as a natural language interface between the user and a number of common operating system related tasks. These include activities such as adding calender reminders, managing personal contacts, sending email and performing web searches.

In a forensics point of view, much of the information Cortana collects can be used for mapping user activity as well as other personally identifiable information. Many users are unaware of the nature of the data that the feature stores and thus are not likely to consider it when attempting to remove forensics artifacts.

In an attempt to provide more geographically relevant results to searches and created events, the GPS location where certain queries were made is stored. This can be used to identify the location of the device at a certain point in time.

Cortana also stores the contact information of other users interacted with. This includes contacts accessed over email, SMS and instant messaging services.

In addition to this, all web searches and the results therein are stored alongside other information.

### 5.34.12 BAM / DAM

Background Activity Moderator (BAM) exists in Windows 10 only after version 1709. It controls the activity of background applications.

Desktop Activity Moderator (DAM) is present only on Windows 8 machines that support connected standby. It controls the activity of desktop applications.

BAM/DAM provides full path of the executable file that was run on the system and the last execution timestamp.

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### 5.34.13 Anti-Forensics Artifacts

OSForensics supports collecting evidences of the following Anti-Forensics tools usage:

- CCleaner
- Eraser
- File Shredder
- R-Wipe and Clean
- BCWipe
- DiskBoss
- Free Wipe Wizard
- Slacker
- VeraCrypt
- AxCrypt
- Gpg4win
- Timestomp
- Tor Browser

### 5.34.14 Downloads

The browser built-in download manager keeps a history of files downloaded.

**Supported Browsers and Evidence Location**

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/History |
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/History |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/History |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/places.sqlite |

**List View Columns (Chrome, Edge-Chromium, Opera)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| File Name | "current_path" or "url" | "downloads" or "downloads_url_chains" |
| Source URL | "url" | "downloads_url_chains" |
| Downloaded To | "current_path" | "downloads" |
| File Size | "received_bytes" | "downloads" |
| Date Download Started | "start_time" | "downloads" |
| Date Download Ended | "end_time" | "downloads" |

**List View Columns (Firefox)**

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| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| File Name | "content" or "url" | "moz_annos" or "moz_places" |
| Source URL | "url" | "moz_places" |
| Downloaded To | "content" | "moz_annos" |
| File Size | "content" | "moz_annos" |
| Date Download Started | "dateAdded" | "moz_annos" |
| Date Download Ended | "content" | "moz_annos" |

**List View Columns (Other)**

OSForensics also scans the files in the location: %USERPROFILE%/Downloads.

| Column Name | Data Origin | Description |
|---|---|---|
| File Name | File attributes | |
| Source URL | - | |
| Downloaded To | File path | |
| File Size | File attributes | |
| Date Download Started | File creation time | |
| Date Download Ended | File creation time | |

## 5.34.15 Browser History

Visited URLs stored on the system.

**Supported Browsers and Evidence Location**

The browser history files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/History<br>%USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/Top Sites |
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/History<br>%USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/Top Sites |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/History |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/places.sqlite |
| Internet Explorer | ESE database<br>Registry | %USERPROFILE%/AppData/Local/Microsoft/Windows/WebCache/WebCacheV01.dat<br>HKEY_CURRENT_USER\Software\Microsoft\Internet Explorer\TypedURLs |
| Edge (Legacy) | ESE database | %USERPROFILE%/AppData/Local/Microsoft/Windows/WebCache/WebCacheV01.dat |

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### List View Columns (Chrome, Edge-Chromium)

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Title | "title"<br>"title" | "urls"<br>"top_sites" |
| URL | "url"<br>"url" | "urls"<br>"top_sites" |
| Date Last Accessed | "last_visit_time"<br>- | "urls"<br>"top_sites" |
| Visit Count | "visit_count"<br>- | "urls"<br>"top_sites" |

### List View Columns (Opera)

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Title | "title" | "urls" |
| URL | "url" | "urls" |
| Date Last Accessed | "last_visit_time" | "urls" |
| Visit Count | "visit_count" | "urls" |

### List View Columns (Firefox)

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Title | "title" | "moz_places" |
| URL | "url" | "moz_places" |
| Date Last Accessed | "last_visit_date" | "moz_places" |
| Visit Count | "visit_count" | "moz_places" |

### List View Columns (Internet Explorer)

| Column Name | Data Origin (column) | Data Origin (table/key) |
|---|---|---|
| Title | -<br>- | -<br>"TypedURLs" key in the Registry |
| URL | "Url"<br>"Data" | "Container_#" table of WebCacheV01.dat file<br>"TypedURLs" key in the Registry |
| Date Last Accessed | "AccessedTime"<br>- | "Container_#" table of WebCacheV01.dat file<br>"TypedURLs" key in the Registry |
| Visit Count | "AccessCount"<br>- | "Container_#" table of WebCacheV01.dat file<br>"TypedURLs" key in the Registry |

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## 5.34.16 Search Terms

Browser history of search terms in search engines.

### Supported Browsers and Evidence Location

The browser search terms files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/History |
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/History |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/History |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/formhistory.sqlite |

### List View Columns (Chrome, Edge-Chromium, Opera)

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Search Text | "term" | "keyword_search_terms" |
| Date Last Searched | "last_visit_time" | "urls" |
| URL | "url" | "urls" |
| Visit Count | "visit_count" | "urls" |

### List View Columns (Firefox)

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Search Text | "value" | "moz_formhistory" |
| Date Last Searched | "lastUsed" | "moz_formhistory" |
| URL | - | - |
| Visit Count | "timesUsed" | "moz_formhistory" |

## 5.34.17 Website Logins

Login credentials of user for websites.

### Supported Browsers and Evidence Location

The browser login data files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/Login Data |

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| Browser | File Format | Location |
|---|---|---|
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/Login Data |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/Login Data |
| Firefox | Json | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/logins.json |

**List View Columns (Chrome, Edge-Chromium, Opera)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Origin URL | "origin_url" | "logins" |
| Action URL | "action_url" | "logins" |
| Username | "username_value" | "logins" |
| Password | "password_value" | "logins" |
| Date First Used | "date_created" | "logins" |
| Date Last Used | "date_last_used" | "logins" |
| Times Used | "times_used" | "logins" |

**List View Columns (Firefox)**

| Column Name | Data Origin (keyword) | |
|---|---|---|
| Origin URL | "hostname" | |
| Action URL | "formSubmitURL" | |
| Username | "encryptedUsername" | |
| Password | "encryptedPassword" | |
| Date First Used | "timeCreated" | |
| Date Last Used | "timeLastUsed" | |
| Times Used | "timesUsed" | |

## 5.34.18 Form History

Auto fill data used to fill the website forms.

**Supported Browsers and Evidence Location**

The browser form history files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/Web Data |

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| Browser | File Format | Location |
|---|---|---|
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/Web Data |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/Web Data |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/formhistory.sqlite |

**List View Columns (Chrome, Edge-Chromium, Opera)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Field Name | "name" | "autofill" |
| Value | "value" | "autofill" |
| Date First Used | "date_created" | "autofill" |
| Date Last Used | "date_last_used" | "autofill" |
| Times Used | "count" | "autofill" |

**List View Columns (Firefox)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Field Name | "fieldname" | "moz_formhistory" |
| Value | "value" | "moz_formhistory" |
| Date First Used | "firstUsed" | "moz_formhistory" |
| Date Last Used | "lastUsed" | "moz_formhistory" |
| Times Used | "timesUsed" | "moz_formhistory" |

## 5.34.19 Bookmarks

Saved web pages for users to quickly visit favorite websites.

**Supported Browsers and Evidence Location**

The browser bookmark data files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | Json | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/Bookmarks |
| Edge (Chromium) | Json | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/Bookmarks |
| Opera | Json | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/Bookmarks |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/places.sqlite |

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| Browser | File Format | Location |
|---|---|---|
| Internet Explorer | Internet Shortcut | %USERPROFILE%/Favorites/ |

**List View Columns (Chrome, Edge-Chromium, Opera)**

| Column Name | Data Origin (keyword) | |
|---|---|---|
| Item | "name" | |
| URL | "url" | |
| Date Added | "date_added" | |

**List View Columns (Firefox)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Item | "title" | moz_bookmarks |
| URL | "url" | moz_places |
| Date Added | "dateAdded" | moz_bookmarks |

**List View Columns (Internet Explorer)**

| Column Name | Data Origin | |
|---|---|---|
| Item | Internet Shortcut file name | |
| URL | "URL" | |
| Date Added | File creation time | |

* Note that MS Edge legacy (before V79) versions are not supported in the OSForensics Bookmarks scan.

## 5.34.20 Chat Logs

OSForensics will search for chat logs from these programs:

- Microsoft Chat
- AIM
- Yahoo
- ICQ
- Skype
- Miranda
- Pidgin

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## 5.34.21 Peer-to-Peer

OSForensics supports collecting forensic artifacts from the following peer-to-peer sharing applications and platforms:

- BitTorrent/uTorrent
- Ares
- eMule
- UseNet (SABnzbd, Newshosting)
- Shareaza

OSForensics also parses the .NZB and .torrent file formats to display their contents details.

**List View Columns**

| Column Name | Description |
|---|---|
| Item | File name. |
| Record Type | - |
| Content Size | Size of the P2P content. |
| Poster | Used for UseNet NZB files and the data is obtained from the "poster" attribute of the NZB file. |
| Content Creation Date | For the NZB files, this data is obtained from the "date" attribute.<br>Note that this time info may not completely reliable as the recorded data was the representation of the date the server saw the shared NZB content, plus the timezones could be different (see the link).<br><br>For the .torrent files, this data is from the value of the key "creation date".<br><br>For the artifacts collected from the BitTorrent/uTorrent resume.data file, this data is obtained from the value of the key "added_on" of the resume.dat file. |
| Evidence Location | - |
| Evidence File Creation Date | The time of the evidence file was created. |
| Date Last Used | The last used time (Last time the server was pinged for eMule Server.met config file OR last torrent seeded time for Shareaza OR last shared time for eMule Known.met). |
| Download Location | For BitTorrent/uTorrent clients, this data is obtained from the value of the key "path" of the resume.dat file. |
| Downloaded Size | For BitTorrent/uTorrent clients, this data is obtained from the value of the key "downloaded" of the resume.dat file. |
| Download Status | - |
| Date Completed | For BitTorrent/uTorrent clients, this data is obtained from the value of the key "completed_on" of the resume.dat file. |

## 5.34.22 Cookies

Cookie are files which are created when users visit websites.

**Supported Browsers and Evidence Location**

The browser cookie files are by default located at:

| Browser | File Format | Location |
|---|---|---|
| Chrome | SQLite | %USERPROFILE%/AppData/Local/Google/Chrome/User Data/[Profile_Name]/Cookies |
| Edge (Chromium) | SQLite | %USERPROFILE%/AppData/Local/Microsoft/Edge/User Data/[Profile_Name]/Cookies |
| Opera | SQLite | %USERPROFILE%/AppData/Roaming/Opera Software/Opera Stable/Cookies |
| Firefox | SQLite | %USERPROFILE%/AppData/Roaming/Mozilla/Firefox/Profiles/[Profile_Name]/cookies.sqlite |

**List View Columns (Chrome, Edge-Chromium, Opera)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Host | "host" | "cookies" |
| Path | "path" | "cookies" |
| Name | "name" | "cookies" |
| Value | "encrypted_value" | "cookies" |
| Date Created | "creation_utc" | "cookies" |
| Date Last Accessed | "last_access_utc" | "cookies" |
| Expiry Date | "expires_utc" | "cookies" |

**List View Columns (Firefox)**

| Column Name | Data Origin (column) | Data Origin (table) |
|---|---|---|
| Host | "host" | "moz_cookies" |
| Path | "path" | "moz_cookies" |
| Name | "name" | "moz_cookies" |
| Value | "value" | "moz_cookies" |
| Date Created | "creationTime" | "moz_cookies" |
| Date Last Accessed | "lastAccessed" | "moz_cookies" |
| Expiry Date | "expiry" | "moz_cookies" |

## 5.34.23 Cryptocurrency Wallet Apps

OSForensics supports collecting evidences of the following Cryptocurrency Wallet applications:

- Binance
- Ledger Live
- Bitcoin Core
- Electrum
- Litecoin Core
- TokenPocket
- Daedalus Mainnet

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- Electron Cash
- Melis Wallet
- Interstellar
- Solar Wallet
- Keybase
- Litemint

## 5.34.24 USB

OSForensics supports collecting evidentiary information from Registry and Windows Event Log that helps in tracking USB devices plugged into a machine.
There are two sub-categories under the USB section.

**USB Devices**
Displays list of USB devices connected.
The different sources of artifacts considered in this category include:

| Artifacts | Location |
|---|---|
| PnP manager log file | [System Drive]:\Windows\INF\setupapi.dev.log |
| Windows Registry hives | SYSTEM\CurrentControlSet\Control\DeviceClasses<br>SYSTEM\CurrentControlSet\Enum\USBSTOR<br>SYSTEM\CurrentControlSet\Enum\USB<br>SYSTEM\CurrentControlSet\Enum\SCSI |
| Windows Event logs Event ID 1006 | [System Drive]:\Windows\System32\winevt\Logs\Microsoft-Windows-Partition%4Diagnostic.evtx |

**USB History**
Displays connection and disconnection timestamps of USB storage devices.
The sources of artifacts considered in this category include:

| Artifacts | Location |
|---|---|
| Windows Event logs Event IDs 2003, 2102<br>Event ID 1006 | [System Drive]:\Windows\System32\winevt\Logs\Microsoft-Windows-DriverFrameworks-UserMode%4Operational.evtx<br>[System Drive]:\Windows\System32\winevt\Logs\Microsoft-Windows-Partition%4Diagnostic.evtx |

*Note that this event logging is not enabled by default.

The "Filter Results for This Device" option in the right-click menu allows you to quickly filter in the specified USB device and only display the relevant information.

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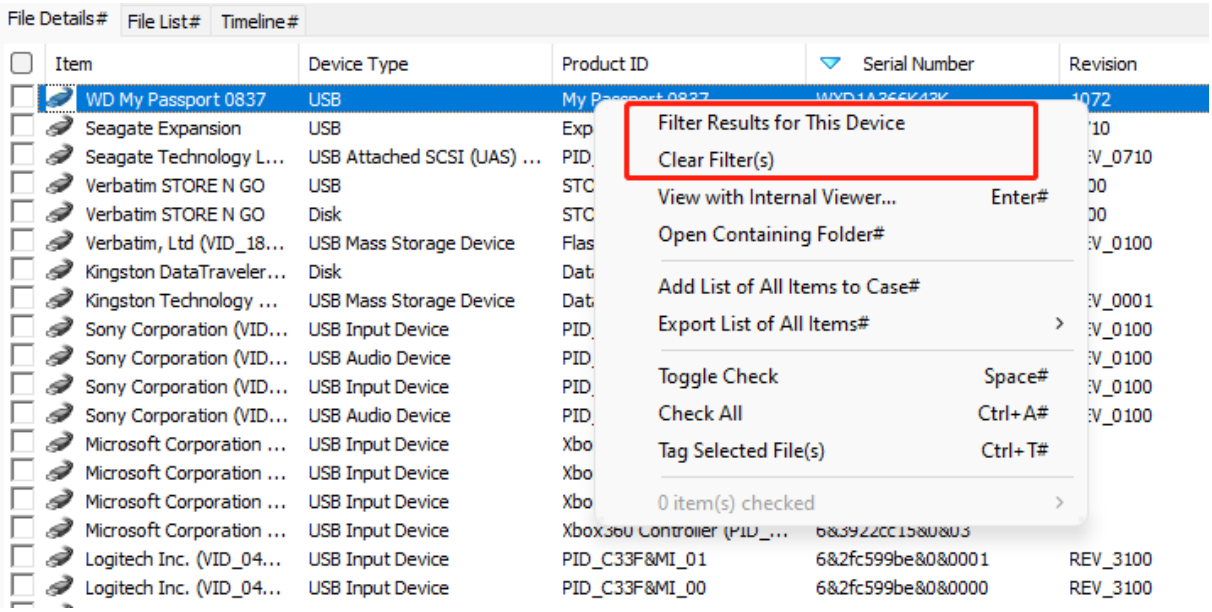


## 5.35 Verify / Create Hash

The Verify / Create Hash module is used for verifying the integrity of files by calculating its hash value. It can also be used to create a hash of a whole partition or physical disk drive or a simple text string.

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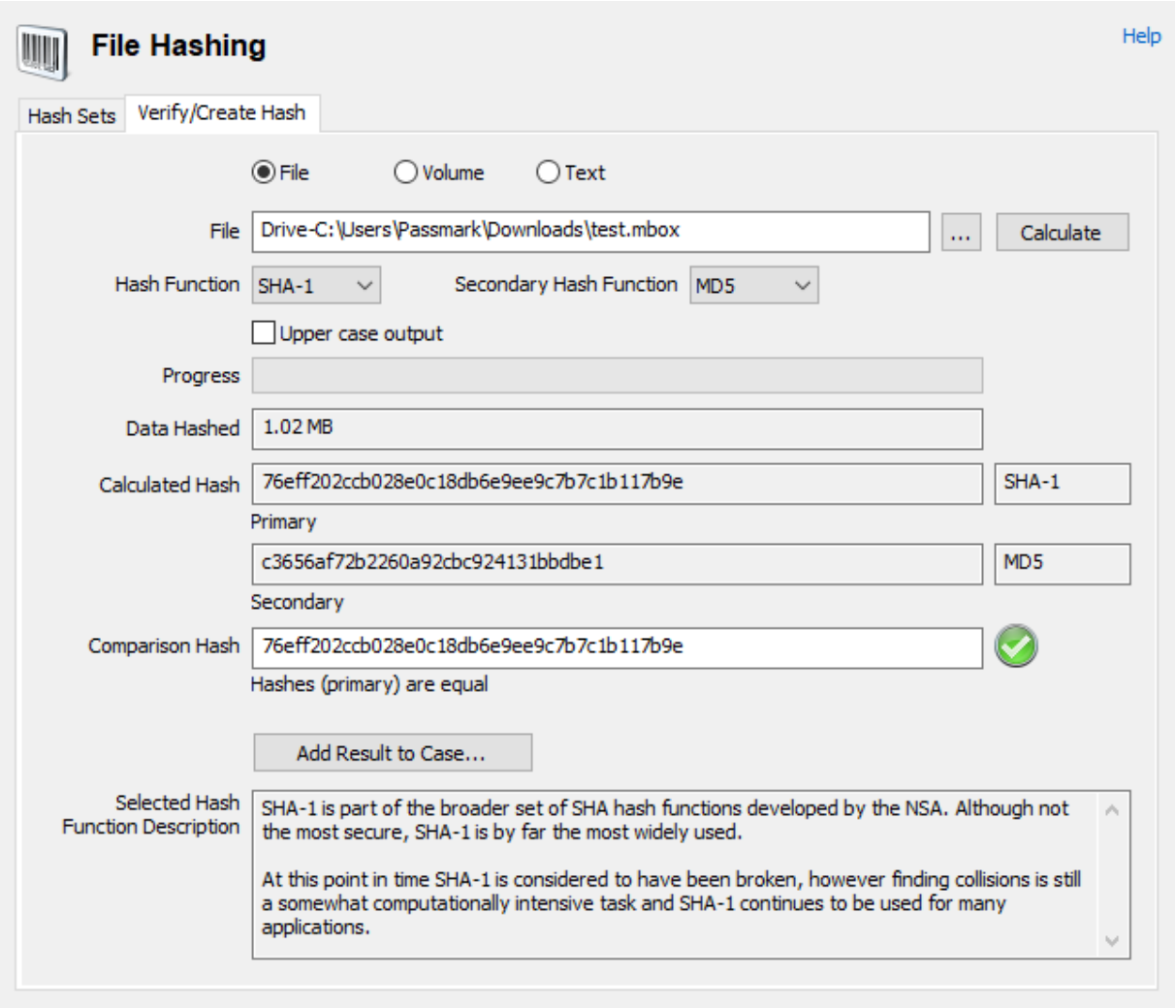


To calculate a hash for a file, simply input the file path, select one of the available hash functions and press Calculate. To verify the calculated hash with a known hash value, copy the known hash value into the Comparison Hash field.

The Comparison Hash may automatically populate if a pre-calculated hash could be detected attached to the selected file.

To create a hash for a partition or drive, select the 'Volume' radio button and then use the drop down to select from the available drives and partition. Note that administrator privileges are required for this feature.

To create a hash of a line of text select the text option and type or paste the text you want to hash into the text field.

**Hash Function / Secondary Hash Function**
Specify the hash function to use for hashing. A secondary hash function can also be specified to calculate the hash value simultaneously.

**Upper case output**
If checked, the calculated hash will be in upper case.

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**Add Result to Case...**
Save the result of the hash calculation and add to the case.

## 5.36 Web Browser

For computers supporting the newer Webview2 based on Chromium Edge the Web Browser module will open in a new window. The Web Browser module provides a basic web viewer from within OSForensics. This module add the ability to load web pages from the web and save screen captures of web pages to the current opened case.

**Caution:**

The internal OSForeniscs' web browser module is implemented Webview2 based on Chromium Edge. Several right click options including "Save As..." and possibly Print will not work due to OSForensics running with elevated permissions. We have not disable the options, but until a workaround is available or the API is changed. the options will not work. If you require those options, you can run OSForensics without elevated permissions, by starting the osf32.exe or osf64.exe executable directly from the the OSForensics program files directory.

### Address Bar

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Allows you to enter an URL to navigate to or shows the current URL of the loaded web page.

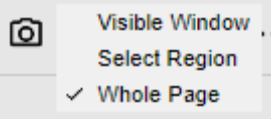
## Navigation Buttons

Not all buttons will be enabled at all times. Buttons (starting from left):

- Back - Load the previous page.
- Forward - Active when the "Back" button has been used. Goes Forward to the recently viewed page.
- Refresh/Stop - Reload the current page or when the page is being loading, stop the current page from loading.

## Screen Capture

Pressing the screen capture button will capture the current page. Different capture options (Visible, Region, Page) allow you to choose what is captured. The image will been prefaced with capture date and the current URL. The captured screen will then be added to the case under "Files".




**Visible Window**
Captures what is current visible in the browser.

**Select Region**
Will bring up on screen prompts to allow you to capture only a certain region of the visible browser. (If the region width selected is too small, the info text added to the top of picture may not be shown completely).

**Whole Page**
The whole page will be saved as an image.

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**Screen Capture showing capture info text and OSForensics watermark.**

*(Note: The **Free** version of OSForensics will have OSForensics logo watermarked throughout the image. The Pro version will not show the watermark.)*

## Save/Export Page

Pressing the following button will launch the export page dialog. The dialog will allow you to capture all the pages currently linked from the Current Page. Or load a site list file to capture.

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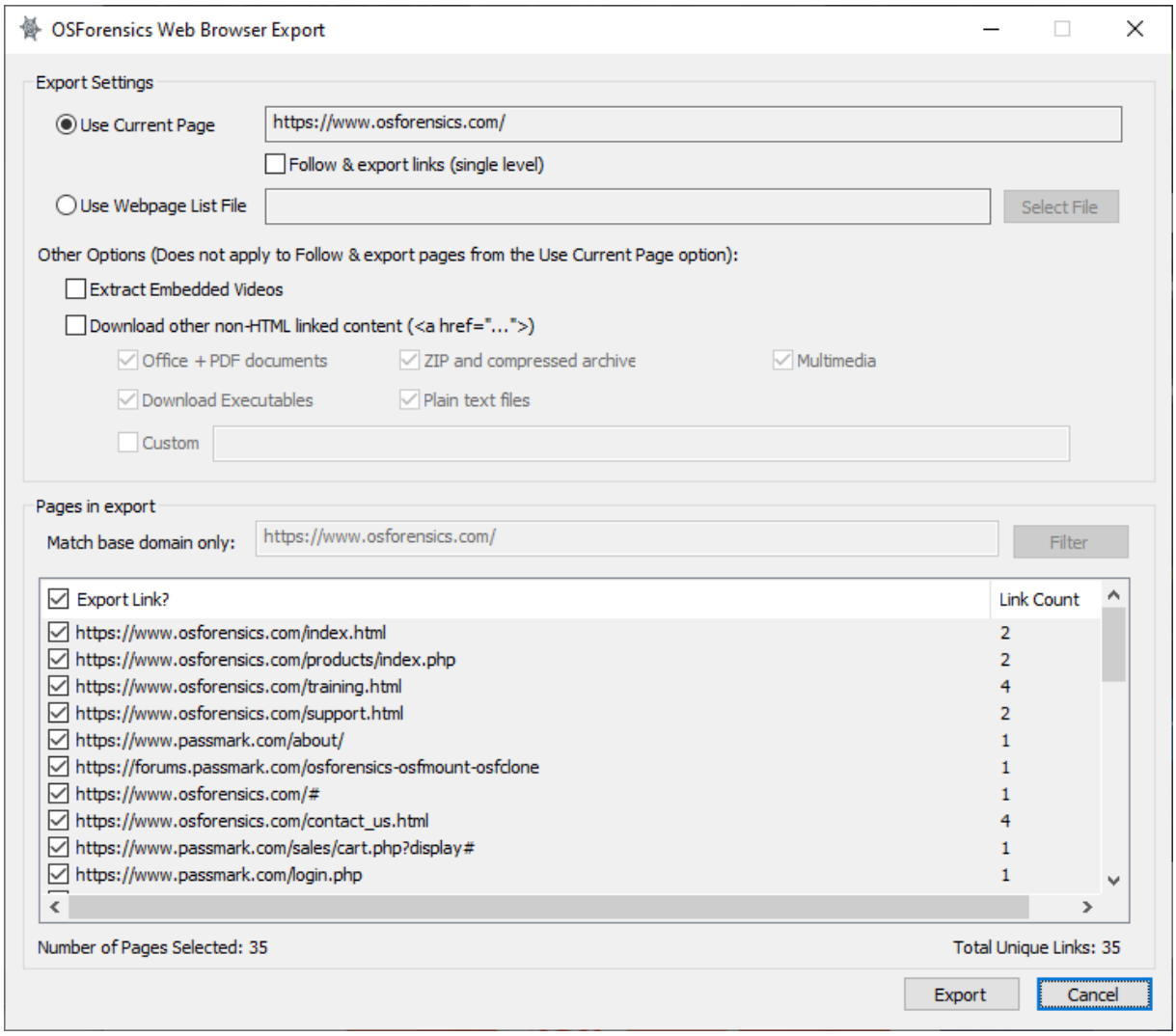


## Export Settings

*Use Current Page* - Use the current page that is loaded in the web browser. Selecting the "Follow & export links" checkbox will also export the pages linked on the current page. Further filtering can be done if not all pages are to be exported.

*Use Webpage List File* - Load a text file containing URLs to export. The list file should place each site on a new line. Lines starting with # are comment lines and will not be loaded.

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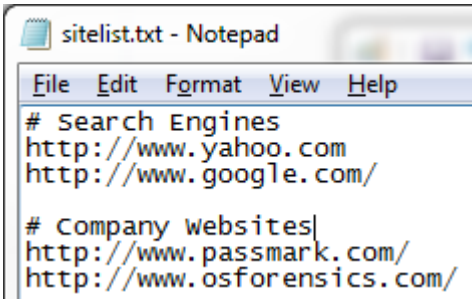


**Other Options** - These options only apply to the top level page only when Use Current Page option or apply to all pages if using Webpage List File. Files will be saved and added to case in a subfolder of where the original case item is located.

*Extract Embedded Video* - Will attempt to extract the first embedded video on the webpage. Video is saved in .mp4 format.

*Download other non-HTML linked content* - Will download and saved other files that may be linked via anchor <a href="..."> on the webpage. User can select a chosen preset or specify their own extensions to download.

- Office + PDF Documents - .doc;.dot;.ppt;.pps;.pot;.xls;.xlt;.docx;.pptx;.xlsx;.dotx;.pdf;.odt;.sxw;.ods;.odp
- Zip and compressed archive - .zip;.tgz;.taz;.tar.gz;.tar;.zipx;.rar;.arj;.dmg;.iso;.chm;.bz2;.lzo;.7z
- Multimedia - .jpg;.jpeg;.jpe;.gif;.tiff;.tif;.png;.bmp;.wmv;.mpg;.mpeg;.rmv;.rmvb;.flv;.mov;.qt;.avi.mp3;.mp4;.mkv;.wma
- Download Executables - .exe;.cab;.msi (*Note: Executable files with .exe extension will be renamed to .exe_ to prevent accidental opening of the file.)*
- Plain Text Files - .txt;.text;.rtf
- Custom - User specified extensions to download, separate extensions with semicolon;

## Pages to Export

If using Current Page as the export option, in addition to the current URL, you can select additional linked pages to be captured. The list will show pages that are linked from the current page. The column Link Count shows how many times the link is found on the current page. If using the Webpage List option, then the list shows what sites were found in the file.

*Match base domain only* - Allow you to filter the list to match certain base domains. Domains should start with http:// or https://. You can specify multiple domains separated by a semicolon ";" character. The filter is case insensitive.

*Export* - This will start the export process of saving the page to your current case. OSForensics will pop up a web browser window during capture process. It is best to leave the capture process alone while it is in progress.

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### 5.36.1 Web Browser (Non-supported OS)

For system that do not support the new Webview2 browser, OSForensics will start the older browser module. The Web Browser module provides a basic web viewer from within OSForensics. This module add the ability to load web pages from the web and save screen captures of web pages to the current opened case.

**Caution**:

The internal OSForeniscs' web browser module is implemented using Microsoft Internet Explorer Web Control COM object. In using the web browser, it will behave similarly to using Internet Explorer on Windows. As such it may leave artifacts (e.g. cookies, temp web files, entries in browser history) on the machine OSForensics is being operated on. Users should take caution if the web browser is being used on a live system that is under investigation.

## Address Bar

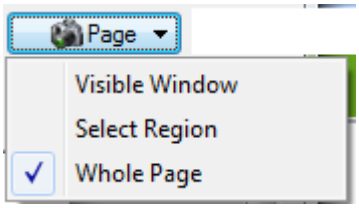
Allows you to enter an URL to navigate to or shows the current URL of the loaded web page.

## Navigation Buttons

Not all buttons will be enabled at all times. Buttons (starting from left):

- Back - Load the previous page.
- Stop - Active when the page is being downloading. Stop the current page from loading.
- Refresh - Reload the current page.
- Forward - Active when the "Back" button has been used. Goes Forward to the recently viewed page.

## Screen Capture




Pressing the screen capture button will capture the current page. Different capture options (Visible, Region, Page) allow you to choose what is captured. The image will been prefaced with capture date and the current URL. The captured screen will then be added to the case under "Files".

**Visible Window**
Captures what is current visible in the browser.

**Select Region**
Will bring up on screen prompts to allow you to capture only a certain region of the visible browser. (If the region width selected is too small, the info text added to the top of picture may not be shown completely).

**Whole Page**
The whole page will be saved as an image.

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**Screen Capture showing capture info text and OSForensics watermark.**

*(Note: The **Free** version of OSForensics will have OSForensics logo watermarked throughout the image. The Pro version will not show the watermark.)*

## Save/Export Page

Pressing the following button will launch the export page dialog. The dialog will allow you to capture all the pages currently linked from the Current Page. Or load a site list file to capture.

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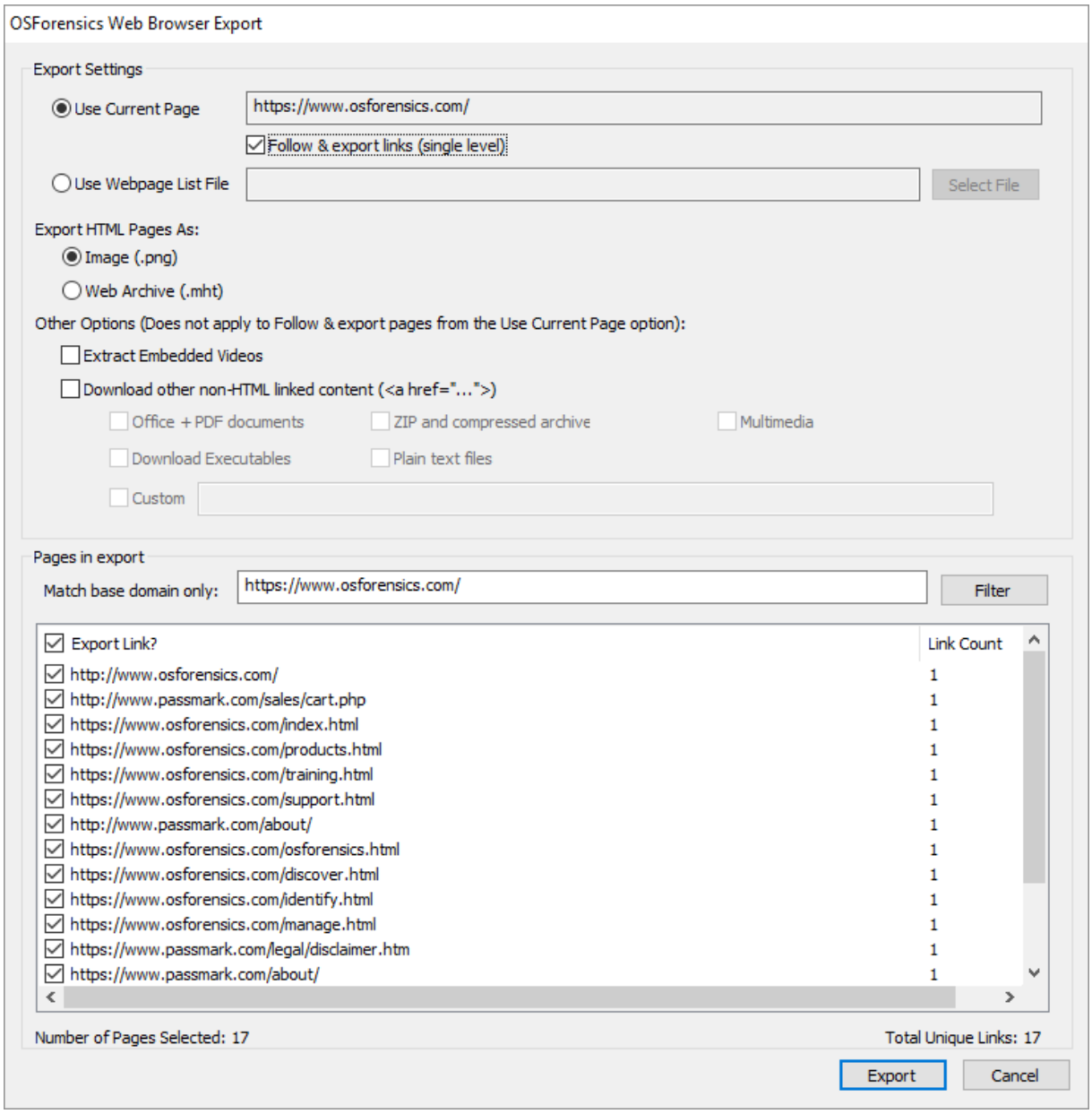


## Export Settings

*Use Current Page* - Use the current page that is loaded in the web browser. Selecting the "Follow & export links" checkbox will also export the pages linked on the current page. Further filtering can be done if not all pages are to be exported.

*Use Webpage List File* - Load a text file containing URLs to export. The list file should place each site on a new line. Lines starting with # are comment lines and will not be loaded.

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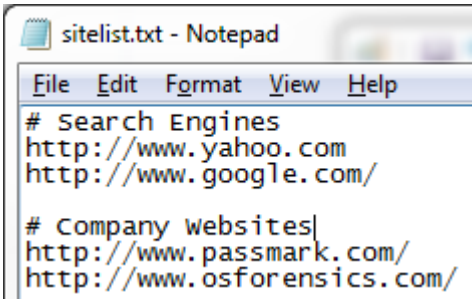


*Export As - Image or Web Archive. P*ages will be saved as .PNGs images or .MHT web-archive format.

**Other Options** - These options only apply to the top level page only when Use Current Page option or apply to all pages if using Webpage List File. Files will be saved and added to case in a subfolder of where the original case item is located.

*Extract Embedded Video* - Will attempt to extract the first embedded video on the webpage. Video is saved in .mp4 format.

*Download other non-HTML linked content* - Will download and saved other files that may be linked via anchor <a href="..."> on the webpage. User can select a chosen preset or specify their own extensions to download.

- Office + PDF Documents - .doc;.dot;.ppt;.pps;.pot;.xls;.xlt;.docx;.pptx;.xlsx;.dotx;.pdf;.odt;.sxw;.ods;.odp
- Zip and compressed archive - .zip;.tgz;.taz;.tar.gz;.tar;.zipx;.rar;.arj;.dmg;.iso;.chm;.bz2;.lzo;.7z
- Multimedia - .jpg;.jpeg;.jpe;.gif;.tiff;.tif;.png;.bmp;.wmv;.mpg;.mpeg;.rmv;.rmvb;.flv;.mov;.qt;.avi.mp3;.mp4;.mkv;.wma
- Download Executables - .exe;.cab;.msi (*Note: Executable files with .exe extension will be renamed to .exe_ to prevent accidental opening of the file.)*
- Plain Text Files - .txt;.text;.rtf
- Custom - User specified extensions to download, separate extensions with semicolon;

## Pages to Export

If using Current Page as the export option, in addition to the current URL, you can select additional linked pages to be captured. The list will show pages that are linked from the current page. The column Link Count shows how many times the link is found on the current page. If using the Webpage List option, then the list shows what sites were found in the file.

*Match base domain only* - Allow you to filter the list to match certain base domains. Domains should start with http:// or https://. You can specify multiple domains separated by a semicolon ";" character. The filter is case insensitive.

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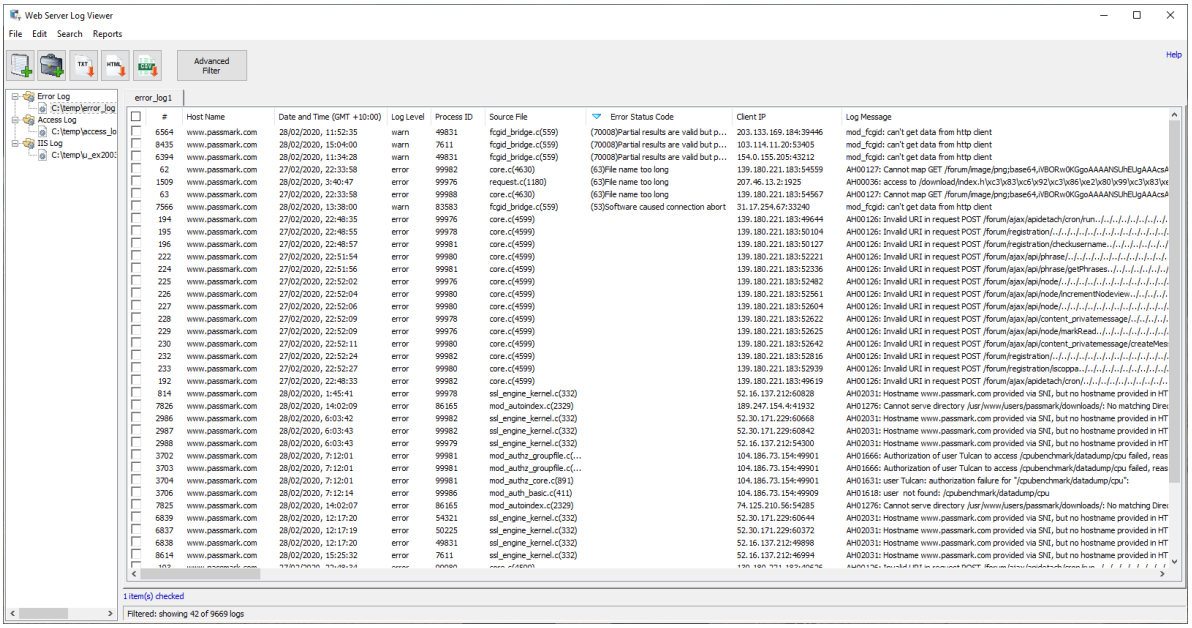
*Export* - This will start the export process of saving the page to your current case. OSForensics will pop up a web browser window during capture process. It is best to leave the capture process alone while it is in progress.

## 5.37 Web Server Log Viewer

The Web Server Log Viewer allows users to extract and analyze log data generated by Apache, IIS, NGINX or other custom web server logs. The below is a list of some of the main features.

- Supports Common, Combined and Custom log formats
- Custom log supports more than 35 different fields
- Supports Apache and NGINX Access Log and Error Log
- Supports IIS W3C Extended, IIS, NCSA log file formats
- Generates Top reports
- Supports IPv4 & IPv6
- Filter by any combination of log fields
- Export to CSV, TXT or HTML
- Automatically filter results that contain common known exploits

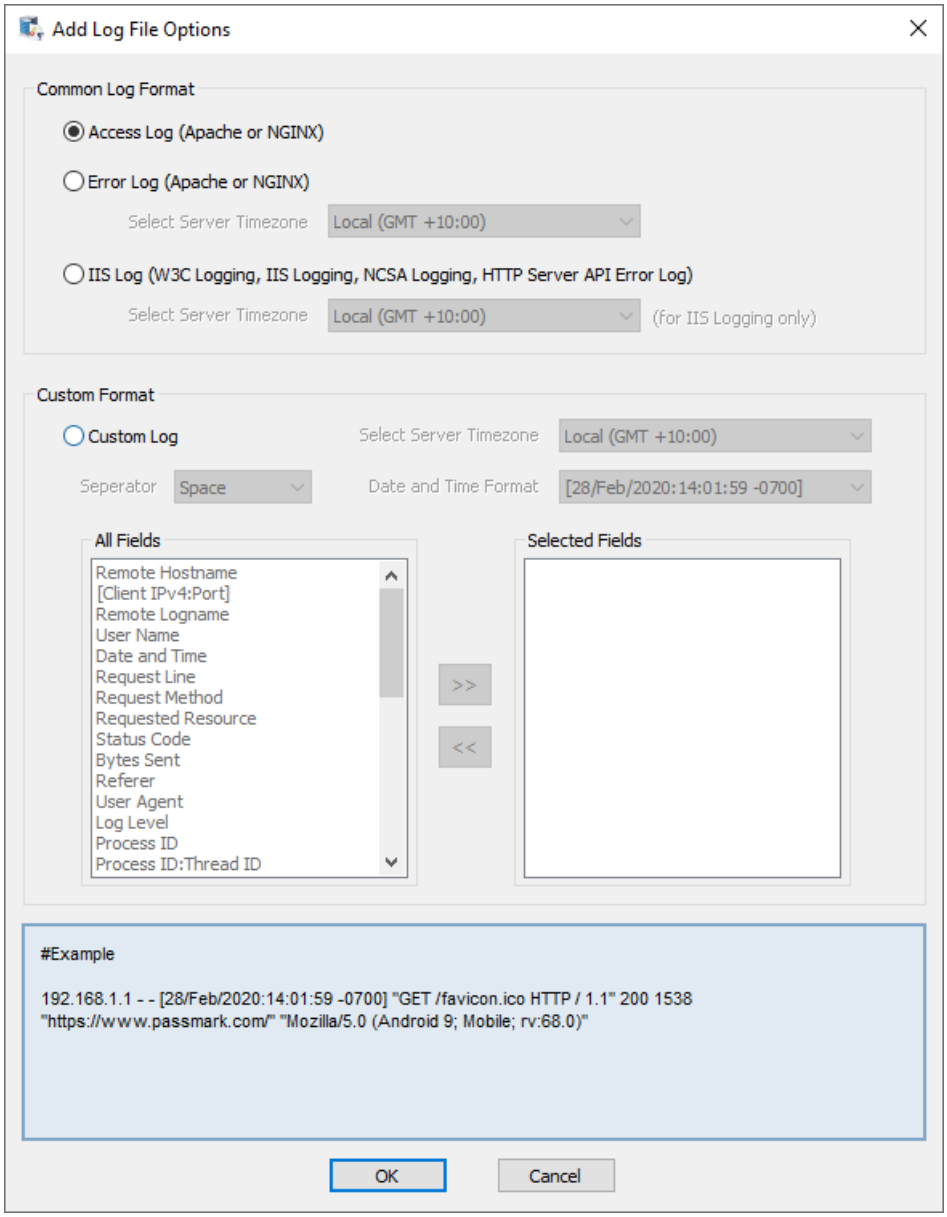



## Usage

### Add Log File

To add log files, select a file to open by clicking Add Log File from the top menu or the image button on the main window. Then the user will be prompted to select Log File Options.

- Access Log
- Error Log
- IIS Log
- Custom Log
- Automatic Filters




## 5.37.1 Access Log

Web Server Log Viewer supports the following Access Log fields.

| Column Name | Format String | Description |
|---|---|---|
| Client IP | %a | Client IP address of the request. |
| Server IP | %A | Local IP address. |
| Bytes Sent | %b | Size of response in bytes, excluding HTTP headers. |
| Cookie | "%{CookieName}C" | The contents of cookie VARNAME in the request sent to the server. |

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| Column Name | Format String | Description |
|---|---|---|
| Time Taken (us) | %D | The time taken to serve the request, in microseconds. |
| Remote Hostname<br>Remote Host IP | %h | Remote hostname or IP address. |
| Protocol Version | %H | The request protocol. |
| Referer | "%{Referer}i" | The referer. |
| User Agent | "%{User-agent}i" | The user agent. |
| Remote Logname | %l | The remote Logname. |
| Log ID (Request) | %L | The request log ID from the error log. |
| Request Method | %m | The request method. |
| Server Port | %p | The canonical port of the server serving the request. |
| Server Actual Port | %{local}P | The server actual port. |
| Client Port | %{remote}P | The client's actual port. |
| URI Query | %q | The query string. |
| Request Method<br>Request Method<br>Protocol Version | "%r" | First line of request. Same as "%m %U%q %H". |
| Status | %>s | The status code. |
| Date and Time | %t | Time the request was received. |
| Time Taken (sec) | %{s}T | The time taken to serve the request, in seconds. |
| Time Taken (ms) | %{ms}T | The time taken to serve the request, in milliseconds. |
| Time Taken (us) | %{us}T | The time taken to serve the request, in microseconds. |
| User Name | %u | Remote user if the request was authenticated. |
| Requested Resource | %U | The URL path requested, not including any query string. |
| Host Name | %v | The canonical ServerName of the server serving the request. |
| Server Name | %V | The server name according to the UseCanonicalName setting. |
| Bytes Received | %I | Bytes received, including request and headers. |
| Bytes Sent (inc headers) | %O | Bytes sent, including headers. |
| Bytes Transferred | %S | Bytes transferred (received and sent), including request and headers. |

Some commonly used Access Log format strings supported by Web Server Log Viewer:

**Common Log Format**

"%h %l %u %t \"%r\" %>s %b"

**Common Log Format with Virtual Host**

"%v %h %l %u %t \"%r\" %>s %b"

**Combined log format (NCSA extended)**

"%h %l %u %t \"%r\" %>s %b \"%{Referer}i\" \"%{User-agent}i\""

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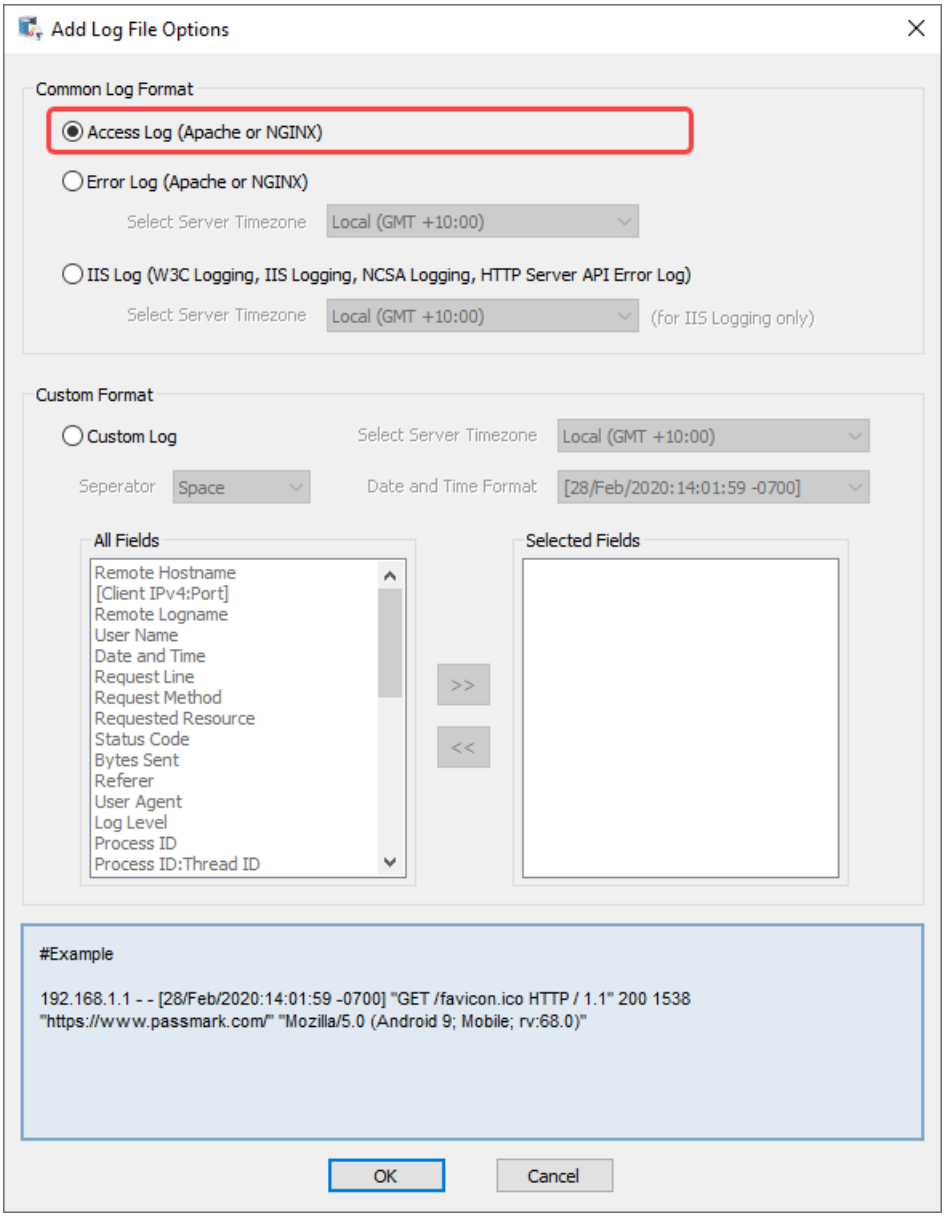
Select Common Log Format > Access Log (Apache or NGINX) option when loading these common log files.
Select Custom Log and choose fields if loading a customized format log.




**Reference**
http://httpd.apache.org/docs/2.4/mod/mod_log_config.html

## 5.37.2 Error Log

Web Server Log Viewer supports the following Error Log fields.

| Column Name | Format String | Description |
|---|---|---|
| Client IP | %a | Client IP address and port of the request. |

| Column Name | Format String | Description |
|---|---|---|
| Server IP | %A | Local IP address and port. |
| Error Status Code | %E | APR/OS error status code and string. |
| Source File | %F | Source file name and line number of the log call. |
| Log Level | %l | Loglevel of the message. |
| Log ID (Request) | %L | Log ID of the request. |
| Module Name | %m | Name of the module logging the message. |
| Log Message | %M | The actual log message. |
| Process ID | %P | Process ID of current process. |
| Thread ID | %T | Thread ID of current thread. |
| Date and Time | %t | The current time. |
| Host Name | %v | The canonical ServerName of the current server. |
| Server Name | %V | The server name of the server serving the request according to the UseCanonicalName setting. |

Some commonly used Error Log format strings supported by Web Server Log Viewer:

**Apache Error Log Format**

"[%t] [%l] [pid %P] %F: %E: [client %a] %M"

**Apache Error Log Format with Virtual Host**

"%v [%t] [%l] [pid %P] %F: %E: [client %a] %M"

**NGINX Error Log Format**

"%t [%l] %P#%T: %M"

Select Common Log Format > Error Log (Apache or NGINX) option when loading these common Error Logs, and choose the Server Timezone set on the server when logging the logs.
Select Custom Log and choose fields if loading a customized format log.

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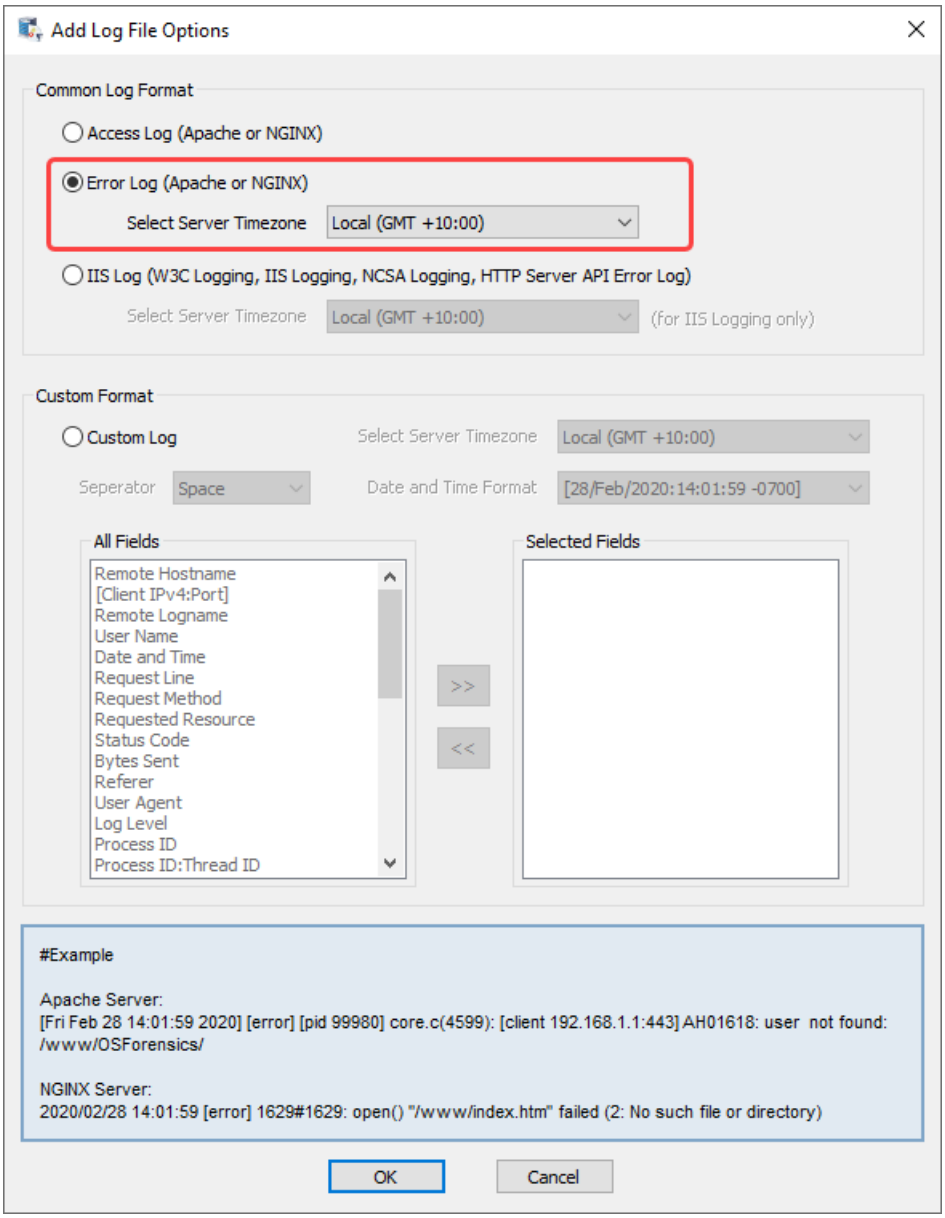


**Reference**
https://httpd.apache.org/docs/2.4/mod/core.html

## 5.37.3 IIS Logs

IIS log formats supported by Web Server Log Viewer:

- W3C Logging
- IIS Logging
- NCSA Logging

FTP Log and HTTP Server API Error Log files with W3C format are also supported.

**W3C Logging:**

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| Column Name | Format String | Description |
|---|---|---|
| Date and Time | date<br>time | The date and time in UTC. |
| Service Name | s-sitename | The Internet service name and instance number that was running on the client. |
| Server Name | s-computername | The name of the server on which the log file entry was generated. |
| Server IP | s-ip | The IP address of the server on which the log file entry was generated. |
| Request Method | cs-method | The requested verb. |
| Requested Resource | cs-uri-stem | The target of the verb. |
| URI Query | cs-uri-query | The query that the client was trying to perform. |
| Server Port | s-port | The server port number that is configured for the service. |
| User Name | cs-username | The name of the authenticated user that accessed the server. |
| Client IP | c-ip | The IP address of the client that made the request. |
| Protocol Version | cs-version | The HTTP protocol version that the client used. |
| User Agent | cs(User-Agent) | The browser type that the client used. |
| Cookie | cs(Cookie) | The content of the cookie sent or received. |
| Referer | cs(Referer) | The site that the user last visited. |
| Host Name | cs-host | The host header name. |
| Status | sc-status | The HTTP status code. |
| Sub-status | sc-substatus | The substatus error code. |
| Win32 Status | sc-win32-status | The Windows status code. |
| Bytes Sent | sc-bytes | The number of bytes sent by the server. |
| Bytes Received | cs-bytes | The number of bytes received and processed by the server. |
| Time Taken (ms) | time-taken | The length of time that the action took, in milliseconds. |
| Stream ID | streamid | The Stream Id. |

**Other supported fields that using W3C extended log file format:**

| Column Name | Format String | Description |
|---|---|---|
| Session ID | x-session | FTP session identifier for the client's session. |
| Full Path | x-fullpath | Full relative path from the FTP root directory for the target of the action. |
| Additional Information | x-debug | Descriptive information for the sc-status code. |
| Client Port | c-port | The port of the client that made the request. |
| URI Query | cs-uri | The URL and any query that is associated with it. |
| Site ID | s-siteid | Not used. A placeholder hyphen always appears in this field. |
| Reason Phrase | s-reason | String that identifies the kind of error that is being logged. |
| Queue Name | s-queuename | The request queue name. |

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**IIS Logging:**

| Column Name | Format String | Description |
|---|---|---|
| Client IP | Client IP address | The IP address of the client that made the request. |
| User Name | User name | The name of the authenticated user that accessed the server. |
| Date and Time | Date<br>Time | The date and time on which the activity occurred. |
| Service Name | Service and instance | The Internet service name and instance number that was running on the client. |
| Server Name | Server name | The name of the server on which the log file entry was generated. |
| Server IP | Server IP address | The IP address of the server on which the log file entry was generated. |
| Time Taken (ms) | Time taken | The length of time that the action took, in milliseconds. |
| Bytes Received | Client bytes sent | The number of bytes sent by the client. |
| Bytes Sent | Server bytes sent | The number of bytes sent by the server. |
| Status | Service status code | Service status code. |
| Win32 Status | Windows status code | Windows status code. |
| Request Method | Request type | The request verb. |
| Requested Resource | Target of operation | The target of the verb. |
| Parameters | Parameters | The parameters that are passed to a scrip. |

The fields in the above table are in the order of occurrence in the IIS Logging log file.
The IIS log file format is a fixed ASCII text-based format that cannot be customized.

**NCSA Logging:**

| Column Name | Format String | Description |
|---|---|---|
| Client IP | Remote host address | The IP address of the client that made the request. |
| Remote Logname | Remote log name | Not used. This value is always a hyphen. |
| User Name | User name | The name of the authenticated user that accessed the server. |
| Date and Time | Date, time, and Greenwich mean time (GMT) offset | The local date and time at which the activity occurred. |
| Protocol Version | Request and Protocol version | The HTTP protocol version that the client used. |
| Status | Service status code | The HTTP status code. |
| Bytes Sent | Bytes sent | The number of bytes sent by the server. |

The NCSA Common log file format is a fixed ASCII text-based format that cannot be customized.

Select Common Log Format > IIS Log (W3C Logging, IIS Logging, NCSA Logging, HTTP Server API Error Log) option when loading these type logs.
Choose the Server Timezone if adding a IIS Logging log file.
Select Custom Log and choose fields if loading a customized format log.

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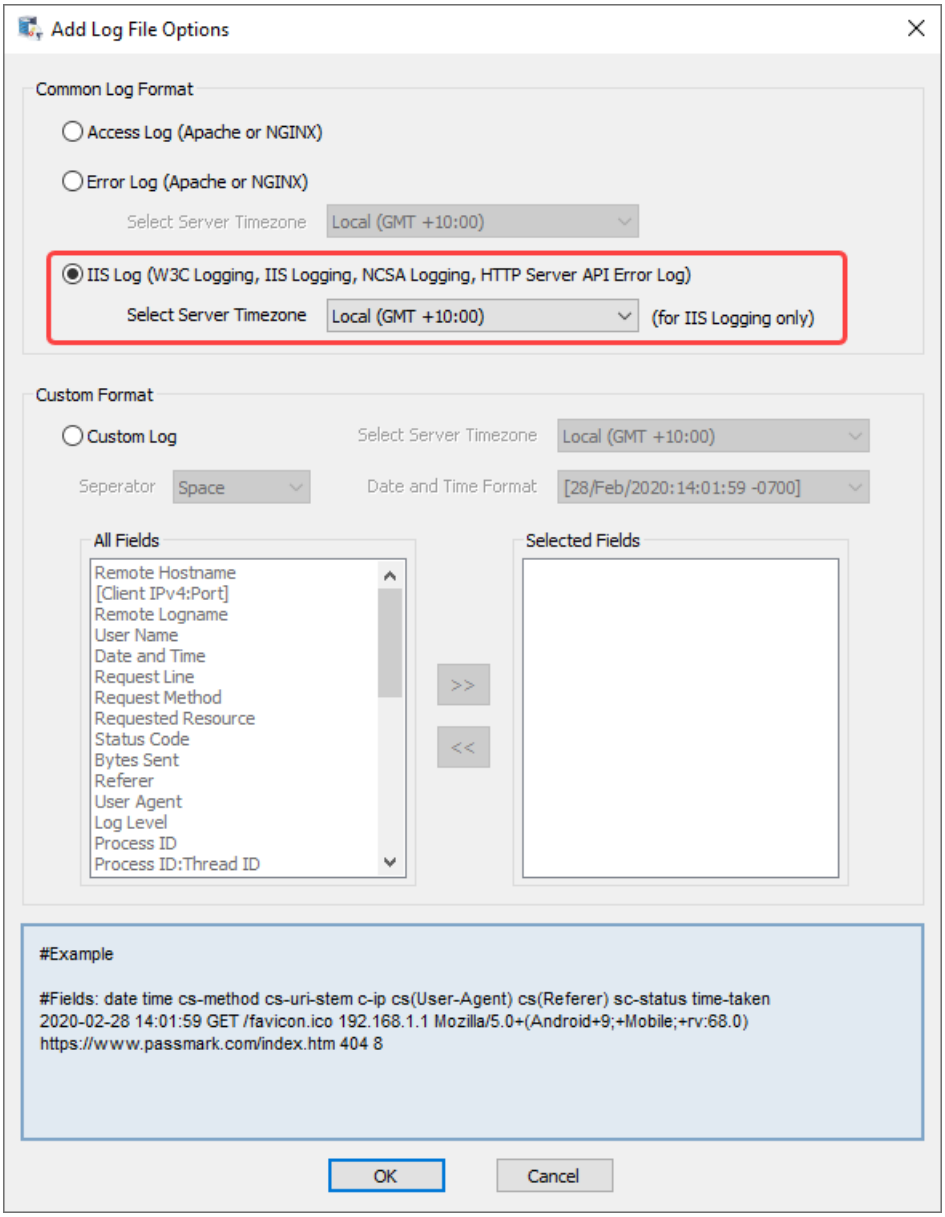


**Reference**
https://docs.microsoft.com/en-us/windows/win32/http/w3c-logging
https://docs.microsoft.com/en-us/windows/win32/http/iis-logging
https://docs.microsoft.com/en-us/windows/win32/http/ncsa-logging
https://docs.microsoft.com/en-us/previous-versions/windows/it-pro/windows-server-2012-r2-and-2012/hh831624(v%3Dws.11)
https://support.microsoft.com/en-au/help/820729/error-logging-in-http-apis

## 5.37.4 Custom Logs

Log formats in various servers are highly configurable, Web Server Log Viewer supports the following custom log fields.

| Column Name | Field | Format String | Description |
|---|---|---|---|
| Remote Hostname | Remote Hostname | %h | Remote hostname or IP address. |
| Client IP | [Client IPv4:Port] | [client %a] | Client IP address and port of the request. |
| Remote Logname | Remote Logname | %l | The remote Logname. |
| User Name | User Name | %u | Remote user if the request was authenticated. |
| Date and Time | Date and Time | %t | Time the request was received. |
| Request Method<br>Request Method<br>Protocol Version | Request Line | "%r" | First line of request. Same as "%m %U%q %H". |
| Request Method | Request Method | %m | The request method. |
| Requested Resource | Requested Resource | %U | The URL path requested, not including any query string. |
| URI Query | URI Query | %q | The query string. |
| Protocol Version | Procol Version | %H | The request protocol. |
| Status | Status Code | %>s | The status code. |
| Bytes Sent | Bytes Sent | %b | Size of response in bytes, excluding HTTP headers. |
| Referer | Referer | "%{Referer}i" | The referer. |
| User Agent | User Agent | "%{User-agent}i" | The user agent. |
| Bytes Sent (inc headers) | Bytes Sent (including headers) | %O | Bytes sent, including headers. |
| Bytes Received | Bytes Received | %I | Bytes received, including request and headers. |
| Bytes Transferred | Bytes Transferred | %S | Bytes transferred (received and sent), including request and headers. |
| Log Level | Log Level | [%l] | Loglevel of the message. |
| Process ID | Process ID | [pid %P] | Process ID of current process. |
| Process ID<br>Thread ID | Process ID:Thread ID | [pid %%P:tid %%T] | Process ID of current process.<br>Thread ID of current thread. |
| Process ID<br>Thread ID | Process ID#Thread ID: | %P:%T: | Process ID of current process.<br>Thread ID of current thread. |
| Source File | Source File | %F: | Source file name and line number of the log call. |
| Error Status Code | Error Status Code | %E: | APR/OS error status code and string. |
| Log Message | Log Message | %M | The actual log message. |
| Server Name | Server Name | %V | The server name according to the UseCanonicalName setting. |
| Host Name | Host Name | %v | The canonical ServerName of the server serving the request. |
| Server IP | Server IP | %A | Local IP address. |
| Client IP | Client IP | %a | Client IP address of the request. |
| Server Port | Server Port | %P | The canonical port of the server serving the request. |
| Server Actual Port | Server Actual Port | %{local}P | The server actual port. |
| Client Port | Client Port | %{remote}P | The client's actual port. |

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| Column Name | Field | Format String | Description |
|---|---|---|---|
| Cookie | Cookie | "%{CookieName}C" | The contents of cookie VARNAME in the request sent to the server. |
| Time Taken (ms) | Time Taken (ms) | %{ms}T | The time taken to serve the request, in milliseconds. |
| Time Taken (us) | Time Taken (us) | %{us}T | The time taken to serve the request, in microseconds. |
| Time Taken (sec) | Time Taken (sec) | %{s}T | The time taken to serve the request, in seconds. |
| Log ID (Request) | Log ID (Request) | %L | The request log ID from the error log. |

Select Custom Log option when loading log files with customized log fields.
Choose the fields and add them to the list in order. Then the #Example will show how the log file looks like.

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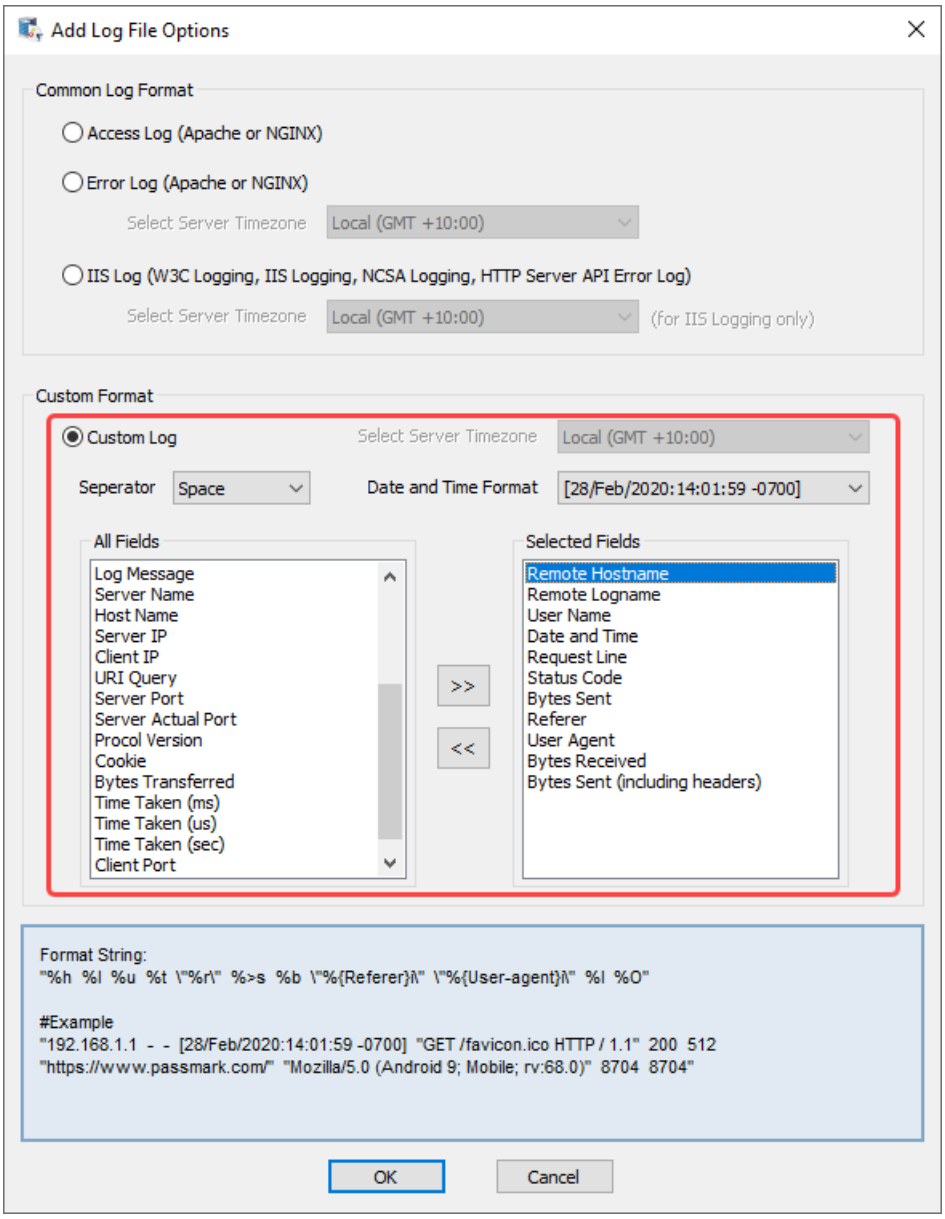


## 5.37.5 Automatic Filters

Automatically filter results according to the most common categories of web server exploits.

Select exploit under Toolbar > Exploit Filters

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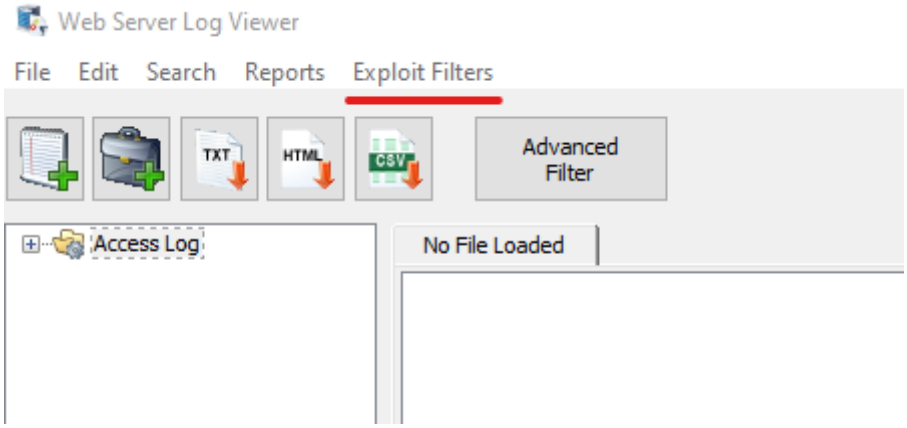
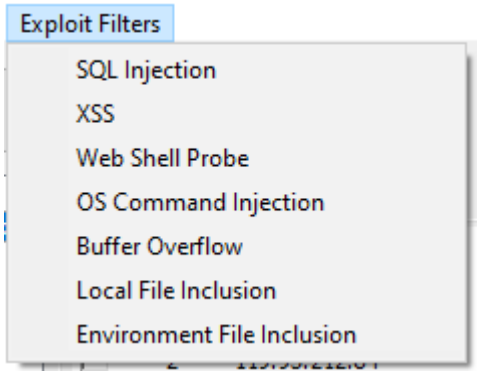



Select Exploit Filters > Filter




Filters are added under the Advanced Filters menu

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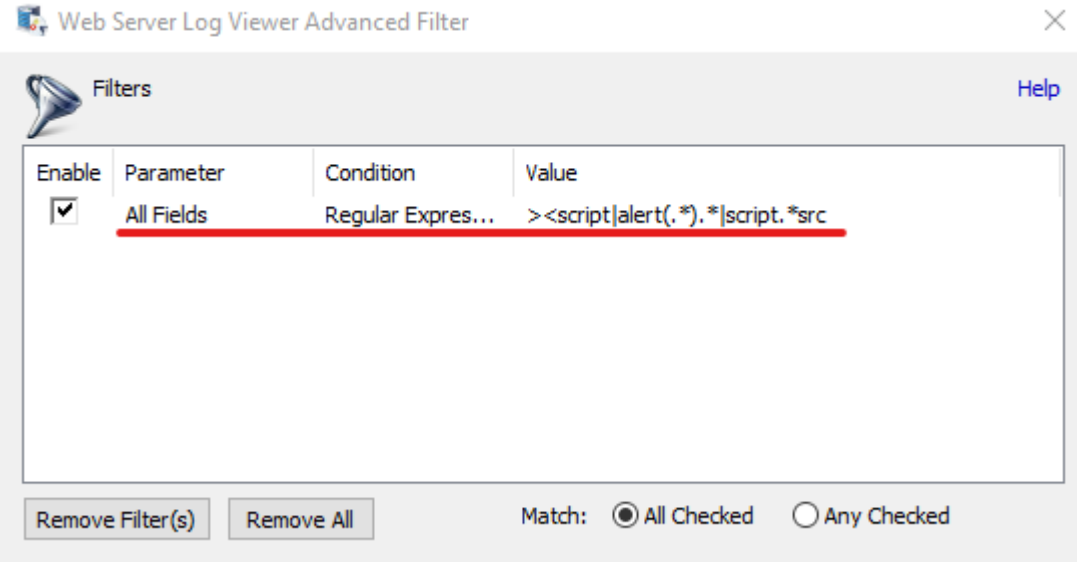


When applying a new filter, all previous advanced filters will be deactivated.

## 5.38 $UsnJrnl Viewer

The $UsnJrnl is a special file in NTFS that tracks the changes to files/directories made to the volume, usually several days to a week. This information is useful for identifying suspect files (eg. malware) that no longer exist in the file system or $MFT. Since Windows Vista, $UsnJrnl logging is turned on by default.

The USN journal is updated whenever changes to files and directories are made to a volume including:

- File Metadata changes
- File Creations
- File Deletions
- File Overwrites

It should be noted that the journal records do not indicate how the file contents have changed, rather whether it has been created, modified or deleted.

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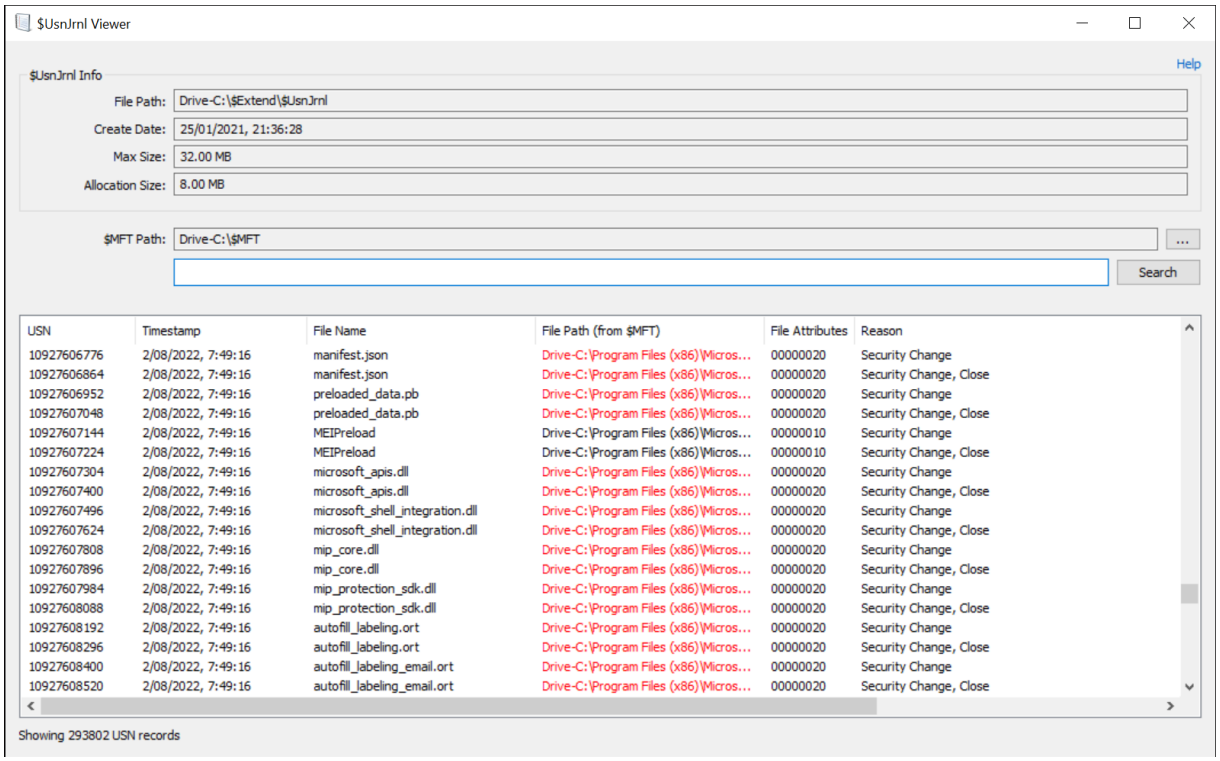
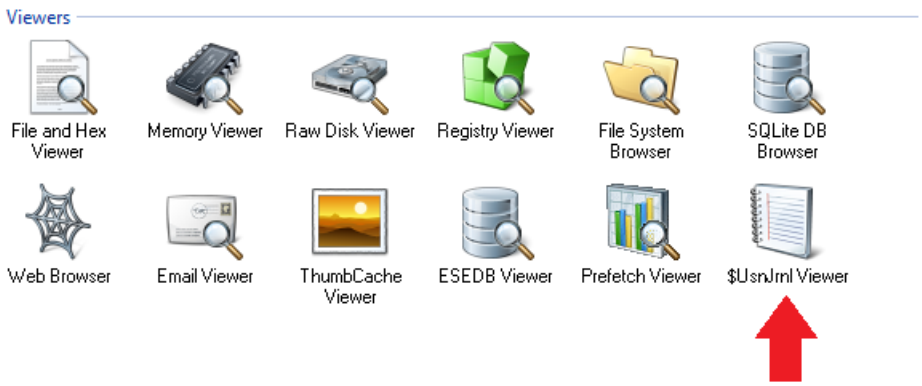



The $UsnJrnl Viewer displays the records of the changes that were made to each file in a volume within a specific time period.

File paths in red indicate files that no longer exist in their original form.

## Opening the $UsnJrnl Viewer

The $UsnJrnl Viewer can be accessed via the "$UsnJrnl Viewer" icon in the "Viewers" group under the Start tab.




Once opened, the location of $UsnJrnl file is displayed for the selected device, if exists. Alternatively, the $UsnJrnl file can be manually selected by clicking the 'Browse' button and locating the file itself. The file can either be the $UsnJrnl file itself or a separate file containing the extracted $UsnJrnl:$J stream.

## Usage

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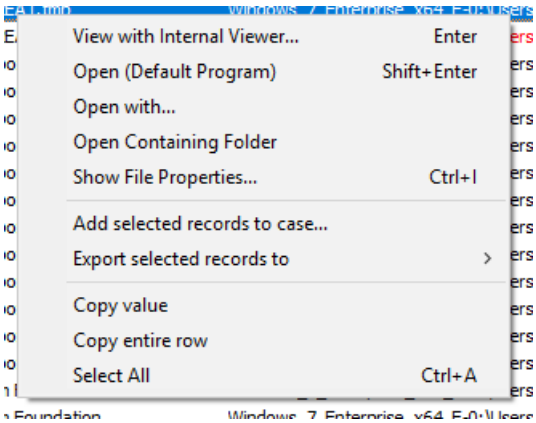
Once the $UsnJrnl file is opened, the table is populated with the list of records contained in the $UsnJrnl file. If the $MFT file exists on the drive's root directory, it shall be automatically parsed to determine the full path of the file referenced in each record. Otherwise, the location of the $MFT file can be manually specified.

## Search

To perform a simple text search of all records in the table, enter a search term and click 'Search'. This will locate records that contain the specified text as it is displayed on the table.

## Right-click Menu




**View with Interval Viewer...**
Opens the file with OSForensics Viewer to perform a more thorough analysis. *Keyboard shortcut: Enter*

**Open (Default Program)**
Opens the file with the default program. *Keyboard shortcut: Shift+Enter*

**Open With...**
Allows the user to select the program to open the file

**Open Containing Folder**
Opens the folder than contains the file

**Show File Properties...**
Opens the file with OSForensics Viewer in File Info mode. *Keyboard shortcut: Ctrl+I*

**Add selected records to case...**
Adds the list of selected records to the case as a CSV file

**Export selected records to**

**txt**
Saves the list of selected records to a text file

**html**
Saves the list of selected records to an html file

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**CSV**
Saves the list of selected records to a CSV file

**Copy value**
Copies the cell as text to the clipboard

**Copy row**
Copies the entire row as text to the clipboard

**Select All**
Select all of the records in the table

# 6 Advanced Topics

Free OSF Helper Tools

Examining System Page File

OSForensics Code Signing

Dates and Times

Regular Expressions

Windows Encrypting File System (EFS)

## 6.1 Free OSF Helper Tools

OSForensics has a number of free helper tools for performing tasks outside the scope of the main application. These can be found at this page.

http://www.osforensics.com/tools/index.html

### OSFClone

OSFClone is a free, self-booting solution which enables you to create or clone exact raw disk images quickly and independent of the installed operating system. After creating or cloning a disk image, you can mount the image with PassMark OSFMount before conducting analysis with PassMark OSForensics.

OSFClone creates a forensic image of a disk, preserving any unused sectors, slack space, file fragmentation and undeleted file records from the original hard disk. Boot into OSFClone and create disk clones of FAT, NTFS and USB-connected drives! OSFClone can be booted from CD/DVD drives, or from USB flash drives.

Verify that a disk clone is identical to the source drive, by using OSFClone to compare the MD5 or SHA1 hash between the clone and the source drive. After image creation, you can choose to compress the newly created image, saving disk space.

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### OSFMount

OSFMount is bundled with OSForensics so there is no need to download this seperately. It can be launched from the side menu withing OSF.

OSFMount allows you to mount local disk image files (bit-for-bit copies of a disk partition) in Windows with a drive letter. You can then analyze the disk image file with PassMark OSForensics™ by using the mounted volume's drive letter. By default, the image files are mounted as read only so that the original image files are not altered.

OSFMount also supports the creation of RAM disks, basically a disk mounted into RAM. This generally has a large speed benefit over using a hard disk. As such this is useful with applications requiring high speed disk access, such a database applications, games (such as game cache files) and browsers (cache files). A second benefit is security, as the disk contents are not stored on a physical hard disk (but rather in RAM) and on system shutdown the disk contents are not persistent.

### ImageUSB

ImageUSB is a free utility which lets you write an image concurrently to multiple USB Flash Drives. Capable of creating exact bit-level copies of USB Flash Drive (UFDs), ImageUSB is an extremely effective tool for the mass duplication of UFDs. ImageUSB can also be used to install OSFClone to a USB Drive for use with PassMark OSForensics™.

Unlike other USB duplication tools, ImageUSB can preserve all unused and slack space during the cloning process, including the Master Boot Record (MBR). ImageUSB can perform flawless mass duplications of all UFD images, including bootable UFDs.

## 6.2 Examining System Page File

The page file is a special system file Windows uses to temporarily offload data out of main memory from time to time. This file can contain portions of volatile data even after the system has been shut down.

Using OSForensics built in file viewer this file can be examined and searched for data strings of interest. It is however not possible to view the page file of an active system to do this the target drive must be mounted in an inactive state. (ie. Windows is not currently running from this drive)

To view the page file. Select "Internal File Viewer" from the OSF start page and browse to the location of pagefile.sys, which is usually located in the root of the drive Windows was installed to. It is possible the page file was moved to another drive or removed entirely by the user however so this will not always be true.

## 6.3 OSForensics Code Signing

OSForensics is protected by a signature across the whole executable to prevent tampering. Any modifications to the executable will remove this signature. This is useful to ensure that no malicious applications on a target machine in a live acquisition can modify OSForensics in order to hide things.

This signature can be viewed by right clicking osf.exe in the OSForensics install directory, selecting properties and going to the "Digital Signature" tab.

If this tab is not there, or the signature is not from "PassMark Software Pty Ltd", the executable has been tampered with.

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## 6.4 Dates and Times

All date and time information in OSForensics is stored internally as UTC. Any date time information read in from external sources that is not already UTC is converted.

When displaying this information the time is converted to the time zone specified in the currently open case. By default this is the local time zone, if no case is open then the local time zone is also used. The case time zone can be modified when creating a new case or changing the properties of the existing case.

The format that the time is displayed in is specified by the current system's regional settings. If you wish to change the date/time display format you can go the the "Region and Language" settings in the Windows control panel.

## 6.5 Regular Expressions

Perl compatible regular expressions (PCRE) are used when filtering the results displayed when browsing the search index. Several regular expression have been pre defined for quick use but you can also type your own regular expressions in the edit below the list. Currently the search is case insensitive, so "TEST" will return the same results as "test".

For example to search for any entry containing the word "test" select the Custom option from the filter drop down list, type "test" and then click the search button. To find only entries that begin with the word "test" use "^test", the "^" character is used to indicate the pattern match must start at the beginning of the found word.

To search for one of the special characters (eg $ ^ .) you will need to escape the character with "\", eg "\.com". For more information on the format and special characters used see the Perl regular expressions help page.

There are several pre-configured regular expressions available from the drop down list, these are found in the the "RegularExpressions.txt" file in the OSForensics program data directory (ProgramData\PassMark\OSForensics). These have been collected from various sources and are kept as simple as possible while still returning fairly accurate results, please note these will not be 100% accurate in all situations.

The RegularExpressions.txt expect 2 lines per regular expression, the first being a name for the expression (that is used for displaying in drop down selection fields) and then the PCRE expression on the next line, for example the first two lines of the default file are;

American Express
3\d{3}(\s|-)?\d{6}(\s|-)?\d{5}

## 6.6 Adding items to a case

Many items have an "Add to case" option in their right click menu. When choosing this option a dialog similar to the one pictured below will be displayed.

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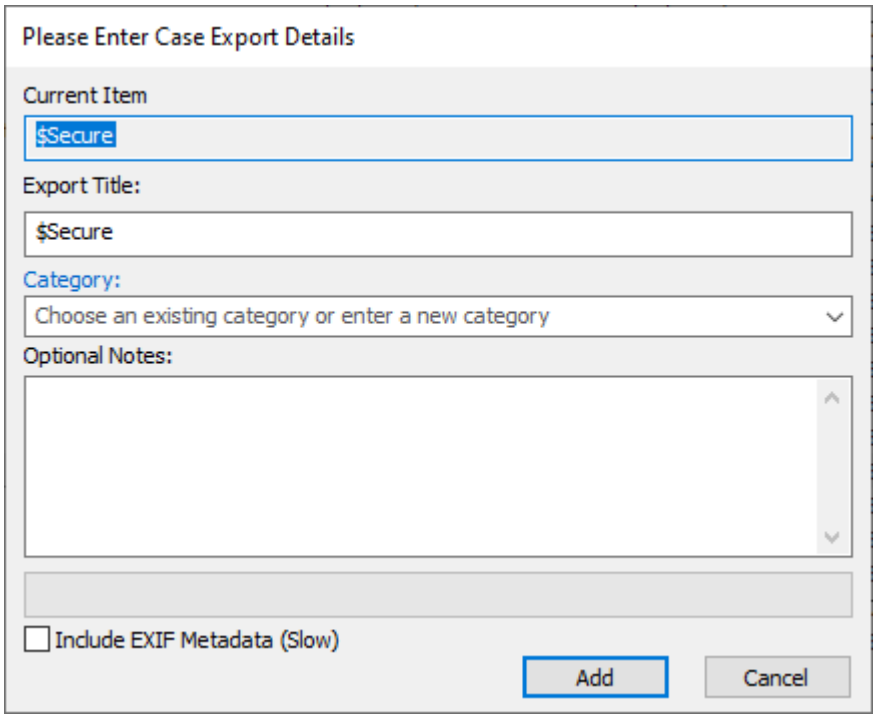


**Current Item**
This is the file name or identifier for the current item and cannot be changed.

**Export title**
This is a title to be used for displaying in the case manager and exported lists & reports. This will default to the current item name or when the "Use same details for all" option is checked will change to the special flag "<Use item name>" and each item will default to using its name as the title.

**Category**
Items can be assigned a category when added to a case, the default list contains entries based on the FBI UCR Program definitions. These categories can be customised by editing the Categories.txt file in the ProgramData\Passmark\Osforensics folder.

**Optional Notes**
Notes to be saved for this file (or collection of files)

**Use same details for all**
When checked will use the same title and notes for each file, see above for an explanation of the "<Use item name>" flag. If this option is selected then the files will be added to the case in a bulk operation without and more user input, otherwise the "Add" button will need to be clicked for each item being added to the case.

**Include EXIF Metadata (Slow)**
When checked will call the command line ExifTool on each file to gather and store any available EXIF metadata which can be a slow process.

## 6.7 Windows Encrypting File System (EFS)

Files on an image that have been encrypted using Windows EFS encryption can be decrypted if the recovery or backup PFX certificate (and any password for the certificate) is available.

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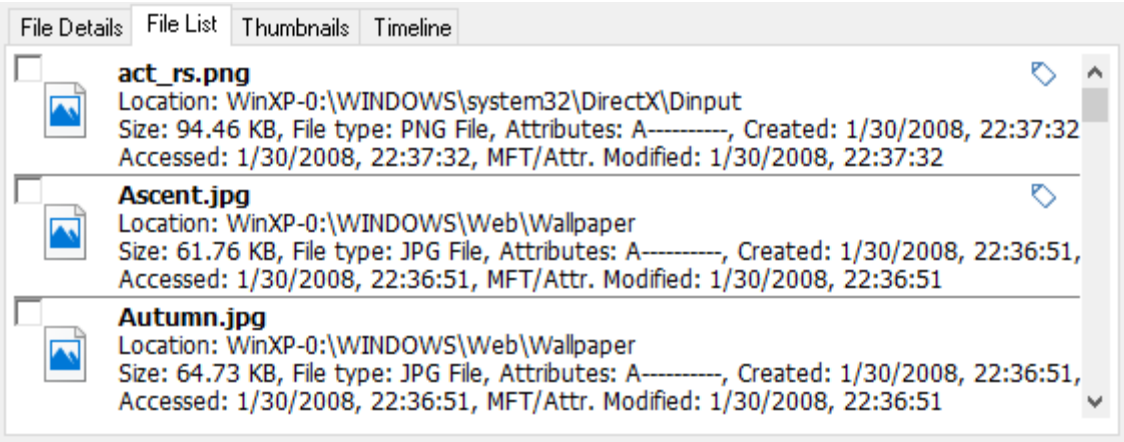
The PFX certificate can be installed to the local machine using the "Install PFX Certificate" tab of the Passwords section of OSForensics. Once the certificate is installed any EFS encrypted files that match the certificate can be exported from an image in OSForensics to a temporary folder and opened in the associated program (eg Word, Notepad etc).

To view and delete installed certificates use the "Open certificate manager" button to open the certmgr windows program, EFS certificates are located in the Personal -> Certificates folder.

## 6.8 Tags

Tags allow forensic investigators to mark any artifact for reference, for later analysis and/or inclusion in the forensics report. Unlike case files, a copy of the tagged item is not saved to the case, but contain hints/information where the item was located so the investigator can go back to review the items in depth later on. As such, thousands of items can be tagged instantaneously for later review.

Most items in OSForensics can be tagged with Ctrl+T keyboard shortcut or have a "Tag Item(s)" option in their right click menu. When tagged, the item appears under "Tagged Items" in the Case Management window. Tagged items are identified with the "tag" icon as follows.




Tagged items can optionally include a title or note, as well as being assigned to a category for grouping with related artifacts.

Artifacts that can be tagged include the following:

- Files
- Deleted files
- E-mail messages
- E-mail attachments
- URLs
- Registry keys
- Thumbnails
- Database records
- Event records
- Disk offsets
- Most user activity artifacts (Mobile, Cookie, Form, P2P, SRUM, Windows timeline, etc)

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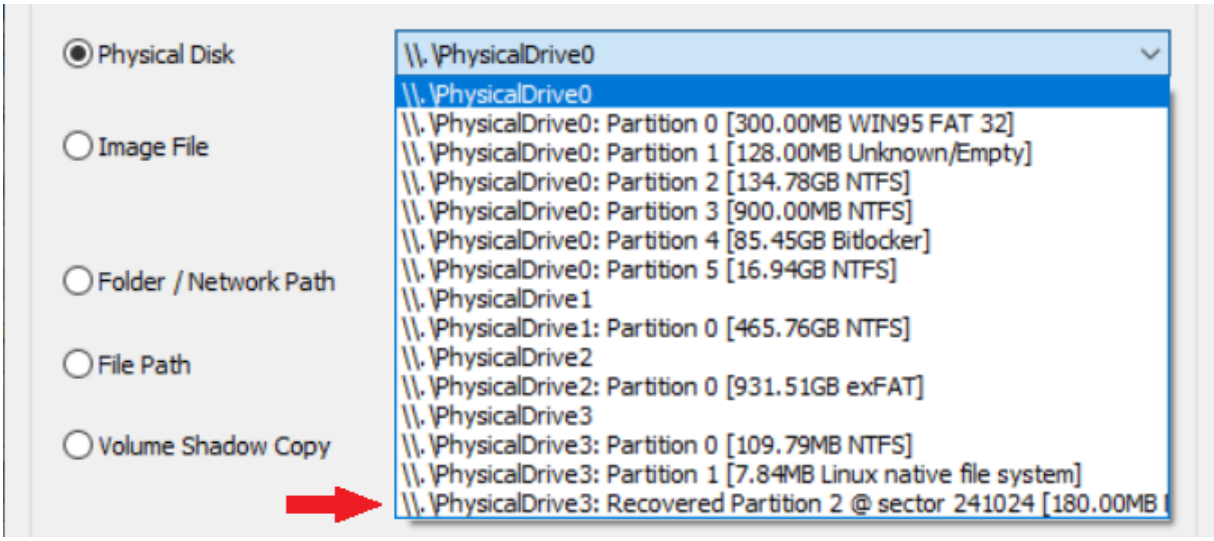
## 6.9 Recovered Partitions

**Recovered Partitions** are remnants of partitions and/or file systems found on a disk but are not indicated in the partition table. These partitions are found in the unpartitioned space of a disk.

Depending on the partitioning tool used, deleting a partition may only remove the entry from the partition table (eg. MBR or GPT), but does not erase the sectors allocated to the partition itself. As a result, the file system data remains on the disk even though the partition no longer exists. For example, Windows Disk Management does not erase the file system data when deleting a volume/partition.

OSForensics supports detection of recovered partitions by scanning the unpartitioned space of a disk for file system signatures. The following screenshot shows a recovered partition found on a disk.




Recovered partitions can be analyzed using OSForensics modules (eg. Deleted Files Search, Raw Disk Viewer) and added to the case just like a normal partition.

# 7 Support

### System Requirements

### License Keys

### Contacting PassMark® Software

### Free Version Limitations

## 7.1 System Requirements

- Win 7, Win 8, Win 10, Win 11; Windows Server 2012, 2016, 2019, 2022 (64-bit O/S recommended)
- Minimum 2GB RAM. (16GB+ recommended, more for large document sets, see this forum post)
- 500MB of free disk space (1GB+ recommended, especially if working with large files)

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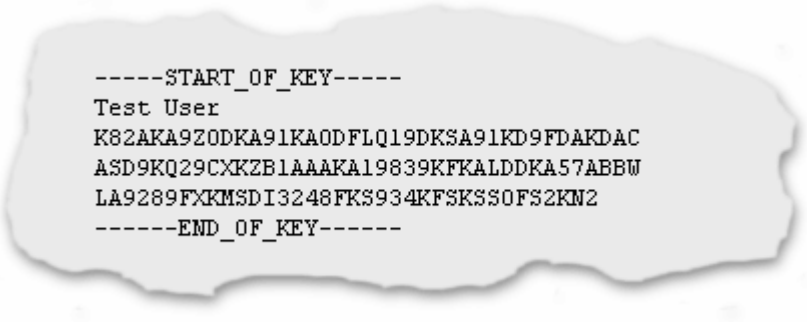
## 7.2 License Keys

After purchasing the software a license key is sent out via E-mail. This license key needs to be entered into the OSForensics software. The registration window can either be accessed form the welcome window by clicking "Upgrade to Professional Version" or using the "Register" button on the navigation side bar.

When entering a license key, copy and paste the license key from the E-mail. Doing a copy and paste will avoid the possibility of a typing mistake.

### Find your license key

After you have placed an order you will receive an e-mail that contains details about your order, your user name and your license key. It should look something like this:



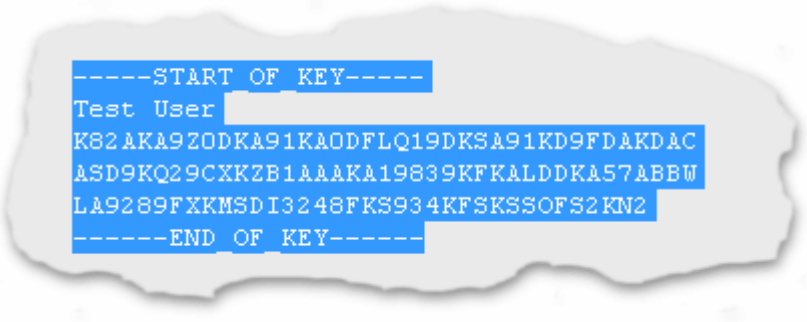

Note that the keys may vary in length and be shorter or longer than the examples above.

### Step 1 - Make sure you have the right software

Make sure that the product that you have downloaded and installed, matches the version of the product you have purchased. Note that the key should be entered in the Free Edition of the software to transform it to the registered edition you purchased. Download and install the latest version of the software, if required.

### Step 2 - Copy your user name and key from the E-mail

Select the entire key, including the -----START_OF_KEY----- and -----END_OF_KEY----- flags:

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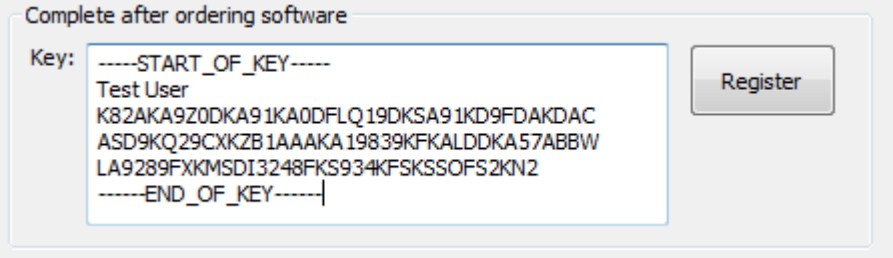
Copy your key to the clipboard. This can be done by using the Edit / Copy menu item in most E-Mail programs. Alternatively you can use the CTRL-C key combination on the keyboard.

## Step 3 - Paste your user name and key into the software

Start OSF and go to the registration window either by clicking "Upgrade to Professional Version" on the welcome window or using the "Register" button on the navigation side bar. Paste the key in the window provided by right clicking and selecting "Paste" or by using the CTRL-V key combination on the keyboard.




Click on "Register". If the user name and key was accepted, the program will restart and identify itself as the registered edition of the software in the title bar of the window.

## Remember to keep your key safe

The e-mail containing the license key should be kept in a safe place in case the software ever needs to be reinstalled. Your User Name and Key will also be required to be re-entered when software upgrades are released.

## Still have a problem?

If you still have a problem, check the following.

- No extra characters were included, be especially careful about not copying extra space characters or new line characters.
- Your user name is exactly as it appears in the E-Mail, using a different user name will not work.
- If you typed in your user name or key, rather than copying and pasting, check that you have not made a typing mistake and check that upper and lower case characters are correct. Upper and lower case are important.

## Contact us

If the above doesn't fix your problem, contact us and describe the problem you have encountered and include your order number and key.

# 7.3 Contacting PassMark® Software

***On the Web***

You can contact PassMark on the web at

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https://www.passmark.com

https://www.osforensics.com

***E-Mail***

For technical support questions, suggestions

help@passmark.com

## 7.4 Free Version Limitations

The following is a list of limitations found in the free version of OSForensics.

- Number of cases limited to 3 at a time.
- Number of items per case limited to 10.
- Cannot undelete multiple files at once.
- Cannot search hard disk for files with multiple streams.
- Cannot create an index of more than 2,500 files.
- Index search results limited to 250 items.
- Cannot export more than 10 user activity items
- Cannot edit system information gathering lists.
- Cannot export hash sets.
- Cannot import the NSRL database into a hash set.
- Password cracking is limited to a single core.
- Number of login details limited to 5 per browser.
- Cannot sort images by color.
- Cannot view NTFS $I30 directory entries
- Web browser screen capture contains a watermark
- Cannot boot without an operating system

To remove these restriction please Purchase OSForensics.

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