



Malwarebytes

# BREACH REMEDICATION

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## Forensic Timeliner Administrator Guide

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## Notices

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## Sample Code in Documentation

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## The Malwarebytes Protection Strategy

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Malwarebytes' products incorporate several prevention features which utilize a layered defense strategy to protect you against malware threats which you face daily. Each layer is designed to disrupt the attack chain at a different stage. While all Malwarebytes products are highly effective in dealing with attacks that are becoming all too commonplace, we can only assure your protection when you take advantage of the full product suite, allowing each prevention layer to do the job they are best suited for.

It's your data. Protect it wisely!

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# Introduction

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*Malwarebytes Forensic Timeliner* (timeliner.exe, or "Timeliner") is a standalone tool, used to generate and display forensic system timelines on Windows systems. It is written in C++ using the Windows API, and is packaged as a single portable Windows executable (EXE) that runs on all modern versions of Windows (Win7 SP1 through Windows 10 clients, 32/64-bit, Servers 2008 through 2012 (32/64-bit), and has no dependencies other than standard Windows DLLs. *Timeliner* must be run either as SYSTEM or as a local administrator on the machine.

*Timeliner* is intended to be used to retrospectively discover and display indicators of prior malware infection, notably the malware's source (when was the malware first created/downloaded/encountered, and where did it come from) and the malware's effects (what other files or artifacts did the malware create, delete, or modify). *Timeliner's* data sources are chosen to help answer these specific questions. For example, the browser history data sources might indicate where on the Internet some malware was downloaded from, and the USN Journal data source might indicate what files the malware might have dropped on the system when executed.

## What's New

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The following changes have been made in this version of *Malwarebytes Forensic Timeliner*:

- Support for usage of proxy server for Internet connectivity

## Key Features

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The following are key features included in *Timeliner*:

- Collect and Export Windows full system historical timeline from many data sources
- Supported log formats include CSV and Event log (CEF)
- Ability to filter/exclude events that may be uninteresting or irrelevant from data sources

## System Requirements

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Following are minimum requirements for an endpoint on which *Timeliner* may be installed. Please note that these requirements do not include other functionality that the endpoint is responsible for.

- **Operating System:** Windows 10, Windows 8.1, Windows 8, Windows 7, Windows Server 2012/2012 R2, Windows Server 2008/2008 R2.  
**PLEASE NOTE:** Windows servers using the Server Core Installation process are specifically excluded
- **CPU:** 800 MHz or faster
- **RAM:** 4 GB (8 GB or more recommended)
- **Free Disk Space:** 1 GB (Note: Output files can exceed 200MB each time *Timeliner* is executed)
- **Screen Resolution:** 800x600 or higher
- **Active Internet Connection**, for license validation and client updates
- **USB 2.0 Port** (optional, depending on deployment method)

## External Access Requirements

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If your company's Internet access is controlled by a firewall or other access-limiting device, you must grant access for *Timeliner* to reach Malwarebytes services. Please assure access is available for:

<https://keystone.mwbsys.com>  
<https://telemetry.malwarebytes.com>



## Data Sources

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*Timeliner* utilizes Windows data sources to generate historical timelines for malware incursions and potential incursions. All data sources are subclasses of the **TimelineSource** abstract class. The following is a list of data sources which are added to the timeline, in alphabetical order.

DATA SOURCE	PURPOSE
ADS (aka. AlternateData)	An <u>A</u> lternate <u>D</u> ata <u>S</u> tream is a Windows feature that is often used for hiding malicious code. It is also used for many legitimate purposes. Only files with alternate data streams are added to the timeline.
AppCompatCache	This is a record of file name, size, last modification and last execution. While a listed file may not have been actually executed, its existence in the cache shows that Windows has interacted with the file.
ChromeBrowserHistory	This provides the Chrome browser history of visited websites.
EventLog	This is a record of user login, logout and system startup events
FirefoxBrowserHistory	This provides the Firefox browser history of visited websites.
IEBrowserHistory	This provides the Internet Explorer browser history of visited websites.
JavaCache	This is a record of all loaded Java applets as recorded by Java's IDX Cache.
Jumplist	Jumplists are lists of recently opened files which are available to an application from the Windows Start Menu.
MFT	The <u>M</u> aster <u>F</u> ile <u>T</u> able contains a record of known file creation times.
MRU	The <u>M</u> ost <u>R</u> ecently <u>U</u> sed List is a chronological record of files which have been opened or accessed.
MUICache	The MUI Cache contains a list of applications which have been executed.
NetworkMap	This is a record of all networked drives which have served as mapped drives for the endpoint.
Prefetch	Prefetch entries aid in speeding up launch of an application. They also contain a record of DLLs used by an application as well as the most recent run time of the application.
RecentFiles	This is a record of shortcuts (*.lnk files) to files recently executed by the user.
RegistryModified	This is an aggregate record of last-modified dates for a variety of registry keys.
Schedule Task	This is a record of tasks which have been scheduled for later or periodic execution.
ShimCache	Used in conjunction with AppCompatCache, this source contains a record of files which have created processes during execution.
USBDrives	This is a record of all USB key attach/detach events
UserAssist	The UserAssist registry key allows determination of how, when and how often programs are launched, on a user-by-user basis.
USN Journal	Uses the <u>U</u> ppdate <u>S</u> equene <u>N</u> umber Journal (change log) to identify all file create, delete, and rename events.
WinShares	This is a record of folders whose read/write access rights have been changed to make the folder available to others.

Notes about individual data sources:

- The **USN Journal** is a circular buffer, and typically contains data for only the last 3-5 days of operation. Based on activity level on the endpoint in question, data may cover more *or* less time.
- The registry data sources (**ShimCache**, **UserAssist**, **MUI**, and **MRU**) are only sometimes present and reliable. They are not complete lists of executed programs. Windows does not maintain a complete list of executed programs.
- **Prefetch** is our most reliable indicator of execution, but it is disabled by default when Windows is installed on a solid-state drive (SSD).

...and some notes about data sources as a whole...

- Because many data sources used by *Timeliner* are ephemeral (notably the **USN Journal**, a circular buffer of unknown size), *Timeliner* should be run as soon as possible after a compromise, but before an anti-malware scan or remediation (which can destroy many indicators used by *Timeliner*).
- Browsers (notably Chrome and Firefox) should be closed during a *Timeliner* run. If left open, their history files will be locked and unavailable to *Timeliner*.
- In order to retrieve timeline events from all user accounts on the machine, *Timeliner* loads user HKCU registry hives (ntuser.dat) into temporary storage under HKU.
- In order to retrieve timeline events from both x86 and x64 native views of the registry on 64-bit versions of Windows, *Timeliner* disables Wow64 redirection for both the registry and the filesystem. Registry redirection is disabled in individual calls to *RegOpenKeyEx*, while filesystem redirection is disabled explicitly by calls to *Environment::DisableFilesystemRedirection* from *Main*.
- Windows API calls are used to read both the MFT and the USN Journal.
- Timeline events with unknown dates are currently stored at "time 0", or "0000-00-00 00:00:00". These events will appear in timelines constructed using the "**collect -date**" switch, unless "**settings -exclude.timeBefore**" is specified (which it is by default).

## Event Logging

When *Timeliner* executes, it produces a log (CSV format) which you may save to a filename of your choice. The screenshot below is a sample from a log produced by *Timeliner*.

Log Time	Data Source	File Path	Event Type	Detail
2018-10-17 15:59:18:518	ChromeHistory	http://www.google.com/	website visited	
2018-10-17 15:59:41:000	EventLog	CLW-2801\$	user logoff	
2018-10-17 15:59:22:000	EventLog	CLW-2801\$	user logon	
2018-10-17 00:15:13:000	EventLog		system startup	
2018-10-16 20:35:25:000	EventLog	jsmith	user logoff	
2018-10-16 20:10:14:000	EventLog	UMFD-1	user logon	
2018-10-16 20:10:14:000	EventLog	DWM-1	user logon	
2018-10-17 16:26:21:171	InternetExplorerHistory	file:///C:/work	website visited	
2018-10-17 16:18:37:213	InternetExplorerHistory	https://support.office.com/client/results?NS=OUTLOOK&Version=16&Lcid=1033&SysLcid	website visited	
2018-10-17 15:08:03:935	JumpListFiles	C:\Program Files (x86)\Google\Chrome\Application\chrome.exe --win-jumplist-action=r	JumpLists	5d696d521de238c3
2018-10-17 16:34:00:427	MFT	C:\Windows\Prefetch\TIMELINER.EXE-BDC6A321.pf	file created	
2018-10-16 17:49:25:402	MRU	C:\Users\jsmith\Desktop\2018-10-16-CLW-2801.zip	file executed	
2018-10-17 15:20:17:053	Prefetch	C:\WINDOWS\SYSTEM32\WIN32U.DLL	file executed	
2018-10-17 14:53:12:631	Prefetch	C:\WINDOWS\SYSTEM32\SAMCLL.DLL	file executed	
2018-10-17 14:49:08:962	Prefetch	C:\WINDOWS\SYSTEM32\WIN32U.DLL	file executed	
2018-10-17 14:49:08:962	Prefetch	C:\WINDOWS\SYSTEM32\WINDOWS_SECURITY.AUTHENTICATION.ONLINEID.DLL	file executed	
2018-10-17 14:49:08:962	Prefetch	C:\WINDOWS\SYSTEM32\SAMCLL.DLL	file executed	
2018-10-17 14:36:54:903	Prefetch	C:\PROGRAM FILES\MALWAREBYTES\ANTI-MALWARE\MBAE64.DLL	file executed	
2018-10-17 14:11:42:731	RecentFiles	C:\Users\jsmith\Documents\Malwarebytes Forensic Timeliner 1.01 Administrator Guide.	file executed	
2018-10-17 13:08:35:037	RegistryModified	HKLM\System\CurrentControlSet\Services\Tcpip\Parameters\Interfaces\{5e164bc1-00dc	registry key (subkey or value) modified	
2018-10-17 16:34:07:632	USNJournal	\\?\C:\Users\jsmith\AppData\Local\Temp\etilqs_SChSaTQz1YqahZM	file created	
2018-10-17 16:33:57:761	USNJournal	\\?\C:\ProgramData\Malwarebytes\MBAMService\LOGS\mbae-protector.xpe	file written	
2018-10-17 16:33:56:364	USNJournal	\\?\C:\ProgramData\Malwarebytes\MBAMService\config\MbamClientConfig.json	file truncated	
2018-10-17 16:33:26:235	USNJournal	\\?\C:\Users\jsmith\AppData\Local\Microsoft\Windows\Caches\cversions.3.db	file overwritten	
2018-10-17 16:33:35:167	USNJournal	\\?\C:\Users\jsmith\AppData\Roaming\Microsoft\Windows\CloudStore\Store\3BDD44B	file security changed	
2018-10-17 16:31:56:101	USNJournal	\\?\C:\Users\jsmith\AppData\Local\MicrosoftEdge\SharedCacheContainers\MicrosoftEd	file renamed FROM (deleted)	
2018-10-17 16:31:56:101	USNJournal	\\?\C:\Users\jsmith\AppData\Local\MicrosoftEdge\SharedCacheContainers\MicrosoftEd	file renamed TO (created)	
2018-10-17 16:31:56:100	USNJournal	\\?\C:\Users\jsmith\AppData\Local\MicrosoftEdge\SharedCacheContainers\MicrosoftEd	file attributes changed	
2018-10-17 16:19:49:211	USNJournal	\\?\C:\Users\jsmith\AppData\Local\Microsoft\Group Policy\History\{688CF64C-9E86-486	file created	
2018-10-17 16:19:49:211	USNJournal	\\?\C:\Users\jsmith\AppData\Local\Microsoft\Group Policy\History\{688CF64C-9E86-486	file written	

## Event Logging to syslog

*Timeliner* integrates very easily into a corporate network, allowing simplified deployment to endpoints as well as subsequent forensic analysis. That integration includes event logging using industry-standard methods. We have implemented logging using CEF (Common Event Format), and more specifically, output is tailored to the ArcSight Security Intelligence platform and others which support the CEF format.

Pages 8-9 describes the four settings which control logging to your existing SIEM. While *Timeliner* automatically generates output files which correspond to each program execution, CEF logging is only performed after the feature has been enabled and properly configured.

# Command Line Parameters

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*Timeliner* supports a variety of command line parameters, which can be used from a command prompt, batch file or script. When used from a script, additional commands may be required to support the scripting model being used.

## Conventions

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The command line structure uses modifiers. These are shown as hyphens (-) immediately preceding parameters. Multiple modifiers may be combined with a parameter. When multiple parameters are used, they must be separated by spaces. In addition, the following conventions are used:

- **text without brackets or braces**  
Items you must type as shown
- **<text inside angle brackets>**  
Required information for which you must supply a value  
Example: `timeliner <parameter_1>`
- **[text inside square brackets]**  
Optional items  
Example: `timeliner [parameter_1]`
- **Grouping of dots (...)**  
A set of specifications  
Example: `timeliner <parameter_1> [parameter_2] ... [parameter_n]`
- **{text inside braces}**  
A set of required items; choose one from the list provided  
Example: `timeliner {0 | 1 | 2 | 3}`
- **vertical bar (|)**  
Separator between mutually exclusive items; choose one  
Example: `timeliner <0 | 1 | 2 | 3>`

## Command Line Overview

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*Timeliner* commands are specified in the following format:

`timeliner { version | register | errorout | collect | settings } [options]`

Following is a list of high-level commands which may be executed. Each command is detailed beginning on the next page.

<b>version</b>	Displays the program version number.
<b>register</b>	Using your license key, this unlocks the features of <i>Malwarebytes Forensic Timeliner</i> . This will also show license status.
<b>errorout</b>	Specifies where error output is directed to.
<b>collect</b>	Defines specifications to be used for data collection, followed by collection itself.
<b>settings</b>	Used to specify universal program settings. These settings are persistent, and are used for program settings which tend to be constants.

In addition, you may type **timeliner** without any additional specifications to see a list of valid commands. This list will span multiple windows if the command line is launched to its default size, so you will achieve best results by stretching the window to show more command line dialog at one time.



## Command Line Reference

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Commands listed here are listed individually. These are primarily used by a system administrator via script, batch file, GPO update, or Remote Desktop. The admin may configure *Timeliner* to operate as a remote task while the endpoint is not in use. When executed from a script, additional commands may be required to support the scripting model being used.

### version

**Usage:**

timeliner version

**Purpose:**

Displays the program version number.

**Parameters:**

none

### register

**Usage:**

timeliner register [-key:<prodkey>]

**Purpose:**

Specifies the unique license key assigned to the partner or customer. This is passed to the licensing server for validation to ensure it is active (non-expired). **A live Internet connection is required.** If the key is valid and the license is active, it will also display status about the license (expiration date, volume purchased, volume used, etc.).

If the key is active, the local installation will operate with this status for 14 calendar days (or the time interval specified in your Malwarebytes license agreement). This “Last Known Good” status is persisted on the USB or wherever the binaries are stored. This allows the USB installation to work as if it were fully registered on offline endpoints or without needing the key.

If **-key** is not specified, license status and the expiration date/time are displayed. **Please note:** If the key is not active, the user may not update threat signature databases, scan for malware, list quarantine contents, or restore files from quarantine.

**Parameters:**

-key:<prodkey>

Specification of <prodkey>, the license key assigned to the user.

### errorout

**Usage:**

timeliner [[-console:{on | off}] [-delete] [-errlog:<file>] | [-reset]]

**Purpose:**

Specifies where error output will be directed to. Values set using this command will persist until they are cleared or modified. Issuing this command without arguments will display current settings.

**Parameters:**

-console:{off | on}

Specifies if error output is displayed on the console. Default value is ON.

-delete

Deletes the output file, if it exists. This command uses the default error log location, unless the error log location has been changed using the **-errlog** switch.

-errorlog:<file>

Specifies the log location for error output. This will overwrite any previously-specified location. If <file> contains any embedded spaces, please enclose <file> in double quotes (“”). The default location is **.\logs\MBBR-ERROUT.TXT**.

-reset

Reverts settings associated with this command back to default values.

## collect

### Usage:

```
timeliner collect [-all]
                  [-target:<string>]
                  [-date:<dateString>]
                  [-output:<fileName>]
                  [-excludeTypes:<eventTypes>]
                  [-includeTypes:<eventTypes>]
```

### Purpose:

Collects forensic data related to possible malware incursions based on criteria specified by the user here. System data may be specified by inclusion of text strings, date/time, and may be set to include or exclude specified event types. Specifications provided here are often changed, so they are not included in **settings**.

### Parameters:

-all

All available system data will be collected.

-target:<string>

Text string to be searched for in the path, or details data fields (See the sample log File). The string is not case-sensitive. Only data containing this string in the path, or details will be collected.

-date:<dateString>

The earliest date/time that data will be collected for. The format for <dateString> is:

**yyyy-mm-dd hh:mm:ss.msec**

All times are local time, and use the 24-hour "military" clock. If a time is not specified, the beginning of the day is used (0 h, 0 m, 0 s, 0 ms). **Please note** that exclude times (before and after, as specified in **settings**) use this parameter as a reference to the date/times that they represent.

-output:<fileName>

Filename which will contain requested data after collection. If a filename is specified, it will override the default filename and save the output file to the program home directory unless a different directory is specified as part of the filename. The default log filename is:

**forensic-log-<hostname>-<yyyy>-<mm>-<dd>-<hh>-<mm>-<ss>**

-excludeTypes:<eventType\_1>[,eventType\_2,eventType\_n]

Event types to be excluded from data collection. When multiple event types are listed, they should be separated by commas. You may use **-excludetypes** or **-includetypes** during a single instance of data collection, but not both.

Event Message types which may be specified are:

CollectStartEvent	CollectEvent	CollectEndEvent
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CollectEvent types which may be specified are:

AlternateData	FileRenamedFrom	RegistryKeyModified
FileAttributesChanged	FileRenamedTo	Shares
FileCreated	FileSecurityChanged	SystemStartup
FileDeleted	FileTruncated	USBDriveAttachedDetached
FileEncryptedDecrypted	FileWritten	UserLogoff
FileExecuted	JumpLists	UserLogon
FileExecutedSubsequent	NetworkMap	WebsiteVisited
FileOverwritten		

-includeTypes:<eventType\_1>[,eventType\_2,eventType\_n]

Event types to be included in data collection. When multiple event types are listed, they should be separated by commas. You may use **-excludetypes** or **-includetypes** during a single instance of data collection, but not both. See parameter **-excludetypes** for a list of event types which may be specified.

## settings

### Usage:

```
timeliner settings [-exclude.browserTIF:true | false]
                  [-exclude.orphaned:true | false]
                  [-exclude.temporary:true | false]
                  [-exclude.goodDirs:true | false]
                  [-exclude.recycled:true | false]
                  [-log.enabled:true | false]
                  [-log.server:<host>]
                  [-log.port:<port>]
                  [-log.test]
                  [-exclude.export:<filename>]
                  [-exclude.import:<filename>]
                  [-exclude.timeBefore:<time>]
                  [-exclude.timeAfter:<time>]
                  [-exclude.installBefore:<time>]
                  [-proxy.clear]
                  [-proxy.enabled:true|false]
                  [-proxy.server:<host>]
                  [-proxy.port:<port>]
                  [-proxy.user:<user>]
                  [-proxy.password:<password>]
```

### Purpose:

This parameter allows a user to define settings that will be used as default specifications for all executions of *Timeliner*. While these settings may be modified at any time, they are typically rather static in nature. Typing “**timeliner settings**” with no additional parameters will display current program settings.

### Parameters:

- exclude.browserTIF:true | false  
Determines whether browser Temporary Internet Files (TIF) are excluded (true) or included (false). The default value is false. A list of all folders containing Temporary Internet Files can be found in Appendix A.
- exclude.orphaned:true | false  
Determines whether orphaned file entries are excluded. Orphaned files sometimes come into existence after they have been deleted, their parent directory entry has been deleted, and the space used by the parent directory entry in the Master File Table has been reallocated. The default value is true.
- exclude.temporary:true | false  
Determines whether temporary files and folders are excluded (true) or included (false). The default value is false.
- exclude.goodDirs:true | false  
Determines whether activity for *known good* folders is excluded from data collection. These folders are listed as [well-known folders] in Appendix A. The default value is true. **Please note** that when gathering data for specific directories (rather than the default “*all*” directories), you may wish to change the value of this parameter to false.
- exclude.recycled:true | false  
Determine whether contents of the Windows Recycle Bin is excluded. The default value is false.
- log.enabled:true | false  
Specifies whether program execution is logged to a syslog server. All data utilizes a CEF (Common Event Format) standard. If this parameter is set to *true*, the *syslog host* IP/FQDN and *port* number must also be specified before event logging can take place. The default value is false.
- log.server:<host>  
IP address or Fully-Qualified Domain Name (FQDN) of a syslog server which will receive event logs generated by *Timeliner*. A valid *port* number must also be specified before logging can take place.

- `-log.port:<port>`  
Valid port number for the syslog server which will receive event logs generated by *Timeliner*. A valid syslog *host* specification must also be specified before logging can take place.
- `-log.test`  
Responds with a text message indicating success or failure in communicating
- `-exclude.export:<filename>`  
Filename that the exclusion list is exported to, typically to allow editing of the list. Filename must be a valid Windows path/filename. If the filename includes embedded spaces, the entire filename must be surrounded by double quotes ("").
- `-exclude.import:<filename>`  
Filename that the exclusion list is imported from. Filename must be a valid Windows path/filename. If the filename includes embedded spaces, the entire filename must be surrounded by double quotes ("").
- `-exclude.timeBefore:<relative time>`  
Exclude data collection for records written to data sources before the specified time. The default value is 1d (one day). You may specify time increments with letters w (weeks), d (days), h (hours), m (minutes), s (seconds) or l (lower case L, representing milliseconds). **Please note** the following:
- All time increments are relative to the date/time specified in **collect -date**.
  - You may combine multiple time specifications (i.e. 1w2d).
  - You may collect data for time windows by combining **timeBefore** and **timeAfter**.
- `-exclude.timeAfter:<relative time>`  
Exclude data collection for records written to data sources after the specified time. The default value is 1d (one day). You may specify time increments with letters w (weeks), d (days), h (hours), m (minutes), s (seconds) or l (lower case L, representing milliseconds). **Please note** the following:
- All time increments are relative to the date/time specified in **collect -date**.
  - You may combine multiple time specifications (i.e. 1w2d).
  - You may collect data for time windows by combining **timeBefore** and **timeAfter**.
- `-exclude.installBefore:<relative time>`  
Exclude data collection for files created before the specified time. The default value is 7d (seven days). You may specify time increments with letters w (weeks), d (days), h (hours), m (minutes), s (seconds) or l (lower case L, representing milliseconds). Please note that time increments are relative to the time that collection begins.
- `[-proxy.clear]`  
Clear all existing proxy settings
- `[-proxy.enabled:true|false]`  
Specifies whether a proxy server is required to access the licensing server. If this parameter is set to *true*, the proxy server host IP/FQDN and port number must also be specified. If authentication is required for proxy access, the user name and password associated with the user name must also be specified. The default value is false (disabled).
- `[-proxy.server:<host>]`  
IP address or Fully-Qualified Domain Name (FQDN) of a proxy server used to access the licensing server. If this parameter is specified, the port must also be specified. If proxy usage is disabled, this parameter is ignored.
- `[-proxy.port:<port>]`  
Valid port number for the proxy server used to access the licensing server. If proxy usage is disabled, this parameter is ignored.
- `[-proxy.user:<user>]`  
User name when proxy usage is enabled and authentication is required. If a password is required, it must also be specified. If proxy usage is disabled, this parameter is ignored.
- `[-proxy.password:<password>]`  
Password for user when proxy usage is enabled. If proxy usage is disabled, this parameter is ignored.

# Logging events to syslog

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*Malwarebytes Forensic Timeliner* integrates very easily into a corporate network, providing highly effective results in the detection and remediation of threats on endpoints. That integration has been extended further through the addition of event logging using industry-standard methods. Based on user requests, we have implemented logging using CEF (Common Event Format), and more specifically, output is tailored to the ArcSight Security Intelligence platform and others which support the CEF format.

This section of the guide is devoted to detailed descriptions of how we have implemented event logging, so that you may easily understand log results and customize reporting in your specific environment.

## Construction of a Log Entry

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All event logs use a standardized format, which consist of an external logger prefix, a header and an extension. They are described as follows:

- **syslog prefix:** A mandatory entry that is applied for compliance with syslog standards. It includes:
  - **Event date**, including month, day and year, in the format (e.g. **Jul 15 2015**)
  - **Event time**, using 24-hour clock, in the format **hh:mm:ss** (e.g. **12:25:40**)
  - **Hostname** which logs pertain to (e.g. **SFO-VM1234.internal.contoso.com**)
- **Header:** Mandatory fields which identify the product/client generating log entries. Vendors may use non-standard field names for these fields, but their usage must correspond to fields and their order within the log record.
  - **CEF Version**, in the format "CEF:<version>". <version> is a single-digit, and is used for compliance with the CEF standard as well as to specify how remaining data should be interpreted.
  - **Device Vendor** identifies the vendor of the product/client which is generating log entries. As it pertains here, this will be "Malwarebytes"
  - **Device Product** identifies the product/client which is generating log entries. As it pertains here, this will be "Malwarebytes Breach Remediation"
  - **Device Version** identifies the product/client version. Malwarebytes Forensic Timeliner is identified not only by the version of the executable, but also by each major components used in conjunction with the program. All components which follow the executable program version are bounded by square brackets. Those components are:
    - Swiss Army Knife(TBD)
  - **Signature ID** is a unique numeric identifier which Malwarebytes has assigned to each event message type. A full list of all Signature IDs can be found later in this section.
  - **Name** is a simple text description for each Collection Event that corresponds to a specific Signature ID
  - **Severity** is the relative importance of any event, with 1 being the least important and 10 representing a critical event.
- **Extension:** This is a series of fields which are not mandatory by CEF standards. These fields represent values that each vendor select for inclusion in their event logs. Because these fields are not mandatory, vendors will commonly use non-standard field names, and may also include labels for the non-standard fields. If a customer elects to use these labels, this would improve readability of log information, though the same label used by multiple vendors may also create confusion for the user.

## Mapping Malwarebytes Fields to CEF Format

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As mentioned previously, log entries are comprised of three separate sections. The *syslog prefix* and *Header* are mandatory, and must conform to rigid standards. The *extension* provides flexibility that vendors require to capture important details related to their products/clients, while still conforming to CEF standards. Malwarebytes is no exception.

CEF Field Usage			
sorted by CEF Standard Field Name			
CEF Standard Field Name	Malwarebytes Field Name	Type	Description -or- Explicit Value
<b>CEF Header</b>			
deviceEventClassId	EventId	integer	Event type
deviceProduct	ProductName	string	Product name
deviceVendor	Company	string	Product vendor's name
deviceVersion	ProductVersion	string	Product version
Name	EventName	string	Event name
Severity	Severity	integer	Severity (1=min, 10=max)
<b>CEF Extension</b> 			
act	Action	string	Action taken with regard to malware
cat	MalwareCategory	string	Either "pu" or "virus"
cs1	MalwareName	string	Name of detected malware
cs2	MalwareHash	string	MD5 hash of detected malware
cs3	SessionId	string	UUID for each MBBR session
cs4	MalwareClass	string	Identifies object type containing malware
cs5	CommandLine	string	Command with arguments executed by user
deviceMacAddress	MACAddress	MAC	MAC address of host where MBBR runs
dvchost	Hostname	string	Hostname where MBBR runs
end	DateTime	time	Event End Date/Time
filePath	FilePath	string	Location of detected malware
msg	*	string	Multi-purpose text string
outcome	Result	string	"succeeded", "failed" Scan commands also allow "stopped", "cancelled"
rt	DateTime	time	Event Date/Time
start	DateTime	time	Event Start Date/Time
suser	UserName	string	Name of user who runs MBBR

As mentioned previously, *msg* is a multi-purpose field. The CEF format provides six fields which may contain custom data, that which the vendor has determined to be important with relation to their product/client, but does not conform to a standard CEF field. Malwarebytes utilizes five of these six fields, and also utilizes *msg* to provide more robust log content. Its usage in each log message will be detailed in the next section.

## Timeliner Log Events

*Malwarebytes Forensic Timeliner* currently generates log entries for nine different event categories. This section of the guide describes each of those categories in detail. The following table lists fields which are common to all log entries created by *Malwarebytes Forensic Timeliner*.

CEF Standard Field Name	Malwarebytes Field Name	Description -or- Explicit Value
<b>CEF Header</b>		
deviceVendor	Company	"Malwarebytes"
deviceProduct	ProductName	"Malwarebytes Forensic Timeliner"
deviceVersion	ProductVersion	Version of program
<b>CEF Extension</b> 		
cs3	SessionId	UUID for each Timeliner session
dvchost	Hostname	Hostname where Timeliner runs
deviceMacAddress	MACAddress	MAC address of host where Timeliner runs
cs5	CommandLine	Command with arguments executed by user
outcome	Results	"succeeded", "failed" Scan commands also allow "stopped", "cancelled"
suser	UserName	Name of user who runs Timeliner

In addition to these common fields, the following events utilize several fields specific to the event being logged. The remainder of this section is devoted to descriptions of each of these events.

### 3000 – CollectStartEvent

3000	CollectStartEvent	Generated when a Collect command is initiated		
	EventName	Severity	Fields	Mapping
	CollectStarted	1	CollectType(string)	msg Format: "start=%s" Value(s): none
			Time	

### 3001 – CollectEvent

3001	CollectionEvent	Generated when a Collect Event occurs		
	EventName	Severity	Fields	Mapping
	CollectArtifact	1	Action	act
			LogTime	cs1 real-time
			Data Source	cs2
			File Path	cs3
			Event Type	cs4
			Detail	cs5

### 3002 – CollectEndEvent

3002	CollectEndEvent	Generated when a Collect command ends		
	EventName	Severity	Fields	Mapping
	CollectEnded	1	CollectedCount(int)	msg Format: "end=%s msg=CollectedCount:%d" Value(s): CollectionCount(int)
			Time	

## Further reading

Malwarebytes recommends that you obtain a copy of the following document from ArcSight. It is a detailed guide pertaining to the CEF logging format, as well as their recommendations targeted to users and developers.

***Implementing ArcSight CEF (Revision 20, dated 05 June 2013)***  
<https://protect724.hp.com/docs/DOC-1072>

# Appendix A: Data Source Exclusions

Default settings for excluded folders used by *Timeliner* are listed below. You can add (exclude from reporting) or remove (include in reporting) an excluded folder at will. To add a new folder to be excluded, simply insert it after a new line in the corresponding folder section. Only one folder may be listed per line, and the allowable wild card is '\*'. To remove an excluded folder, you may delete it or put a semicolon in front of the folder entry. To include a subfolder under an excluded folder, you must insert it under the excluded folder and put a '+' in front of the folder entry. Here is an example:

```
*\Windows\AppCompat\*           Do not report on files in this folder tree
+*\Windows\AppCompat\Programs\*  Report on files in this folder tree
```

To bring the new settings into effect, please run:

```
timeliner setting -exclude.import:<filename>
```

Where <filename> is the name of the file which the exclude list was previously exported to. This method provides granularity to allow inspection of the file system.

## [well-known folders]

```
*\.git\*
*.obj
*.lck
*\pagefile.sys
*\Config.Msi
*\.Extend\*
*\System Volume Information\*
*\Users\sshd_server\*
*\Users\*\.NTUSER.DAT*
*\Windows\AppCompat\*
*\Windows\AppReadiness\*
*\Windows\assembly\*
*\Windows\Boot\*
*\Windows\Fonts\*
*\Windows\IME\*
*\Windows\inf\*
*\Windows\Logs\*
*\Windows\Installer\*
*\Windows\L2Schemas\*
*\Windows\Microsoft.NET\*
*\Windows\Microsoft .NET\*
*\Windows\PolicyDefinitions\*
*\Windows\Registration\*
*\Windows\rescache\*
*\Windows\ServiceProfiles\*
*\Windows\Servicing\*
*\Windows\SoftwareDistribution\*
*\Windows\System32\catroot\*
*\Windows\System32\catroot2\*
*\Windows\System32\config\*
*\Windows\System32\DriverStore\FileRepository\*
*\Windows\System32\GWX\*
*\Windows\System32\LogFiles\*
*\CCleaner\*
*\Cisco Systems\*
*\Cisco\*
*\Citrix\*
*\Common Files\Adobe\*
*\Common Files\Apple\*
*\Windows\System32\MsDtc\*
*\Windows\System32\spool\*
*\Windows\System32\spp\*
*\Windows\System32\sru\*
*\Windows\System32\Sysprep\*
*\Windows\System32\Tasks\Microsoft\*
*\Windows\System32\wdi\*
*\Windows\System32\wbem\Performance\*
*\Windows\System32\wbem\Repository\*
*\Windows\Winsxs\*
*\AppData\Local\Packages\Microsoft.*
*\AppData\LocalLow\Microsoft\*
*\AppData\Roaming\Microsoft\Windows\Themes\*
*\ProgramData\Microsoft\*
+*\ProgramData\Microsoft\Windows\Start Menu\*
*\Microsoft\Windows\Sqm\*
*\Microsoft\Windows\Recent\AutomaticDestinations\*
*\Microsoft\Windows\Recent\CustomDestinations\*
*\SystemIndex\Indexer\CiFiles\*
*\3M\*
*\Acronis\*
*\Adobe\*
*\Apple Computer\*
*\ArcSoft\*
*\ASUS\*
*\ATI Technologies\*
*\AVAST Software\*
*\Avira\*
*\Bonjour\*
*\Box\*
*\Box Sync\*
*\Broadcom\*
*\Carbonite\*
*\OpenSSH\*
*\OpenVPN Technologies\*
*\Panda USB Vaccine\*
*\QuickTime\*
*\Realtek\*
*\Reference Assemblies\*
```



**[well-known folders]** (continued)

- \*\Common Files\Java\\*
- \*\Common Files\Microsoft Shared\\*
- \*\Common Files\VMware\\*
- \*\COMODO\\*
- \*\CrashPlan\\*
- \*\CyberLink\\*
- \*\Dell\\*
- \*\Dropbox\\*
- \*\EPSON Software\\*
- \*\Fiddler2\\*
- \*\Fitbit Connect\\*
- \*\Foxit Reader\\*
- \*\G Data\\*
- \*\Google\\*
- \*\Hewlett-Packard\\*
- \*\HP\\*
- \*\Intel\\*
- \*\Internet Explorer\\*
- \*\iPod\\*
- \*\iTunes\\*
- \*\Java\\*
- \*\Kaspersky Lab\\*
- \*\LANDesk\\*
- \*\LastPass\\*
- \*\Lenovo\\*
- \*\Logitech\\*
- \*\Malwarebytes Anti-Exploit\\*
- \*\Malwarebytes Anti-Malware\\*
- \*\McAfee\\*
- \*\Microsoft Analysis Services\\*
- \*\Microsoft Games\\*
- \*\Microsoft Office 15\\*
- \*\Microsoft Office\\*
- \*\Microsoft Silverlight\\*
- \*\Microsoft SQL Server Compact Edition\\*
- \*\Microsoft SQL Server\\*
- \*\Microsoft Sync Framework\\*
- \*\Microsoft Synchronization Services\\*
- \*\Microsoft Visual Studio 8\\*
- \*\Mozilla\\*
- \*\Mozilla Firefox\\*
- \*\Mozilla Maintenance Service\\*
- \*\NVIDIA Corporation\\*

**[temporary folders]**

- \*.tmp
- \*.temp

**[browserTIF folders]**

- \*\Firefox\\*
- \*\Chrome\\*
- \*\Cache\\*
- \*\Temporary Internet Files\\*
- \*\Content.IE5\\*
- \*\History.IE5\\*
- \*\Cookies\\*

- \*\Reference Assemblies\Microsoft\\*
- \*\SAMSUNG\\*
- \*\Sandboxie\\*
- \*\Seagate\\*
- \*\Skype\\*
- \*\Sophos\\*
- \*\Spotify\\*
- \*\Stardock\\*
- \*\Steam\\*
- \*\Symantec\\*
- \*\TAP-Windows\\*
- \*\TeamViewer\\*
- \*\TechSmith\\*
- \*\TextPad 5\\*
- \*\Thunderbird\\*
- \*\TOSHIBA\\*
- \*\Trend Micro\\*
- \*\uTorrent\\*
- \*\USOShared\\*
- \*\USOPrivate\\*
- \*\VideoLAN\\*
- \*\VLC\\*
- \*\VMware\\*
- \*\WebEx\\*
- \*\Webroot\\*
- \*\Western Digital\\*
- \*\WindowsApps\\*
- \*\Windows Defender\\*
- \*\Windows Journal\\*
- \*\Windows Kits\\*
- \*\Windows Mail\\*
- \*\Windows Mail\\*
- \*\Windows Media Player\\*
- \*\Windows Multimedia Platform\\*
- \*\Windows NT\\*
- \*\Windows Photo Viewer\\*
- \*\Windows Portable Devices\\*
- \*\Windows Sidebar\\*
- \*\WindowsPowerShell\\*
- \*\WinRAR\\*
- \*\WinZip\\*
- \*\Wireshark\\*
- \*\Yahoo!\\*

- \*\Temp\\*

- \*\INetCache\\*
- \*\INetCookies\\*
- \*.sbstore
- \*.cache
- \*.pset
- \*\Windows\System32\IE11\WIN10\_\*

**[recycle bin folders]**

\*\RECYCLER\  
\*\RECYCLED\  
\*\RECYCLED\\*

\*\Recycle.Bin\  
\*\\$Recycle.Bin\  
\*\\$Recycle.Bin\\*

# Appendix B Mapping Data Sources to Event Types

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The following list maps the event types which data may be collected for, and the data sources where this data originated.

Available filtering event types are:

<b>EVENT TYPE</b>	<b>DATA SOURCE</b>
AlternateData	ADS
FileAttributesChanged	USN Journal
FileCreated	MFT
	USN Journal
FileDeleted	USN Journal
FileEncryptedDecrypted	USN Journal
FileExecuted	AppCompatCache
	JavaCache
	MRU
	MUICache
	Prefetch
	RecentFiles
	RegistryLoadPoints
	ShimCache
	UserAssist
	WinJob
FileExecutedSubsequent	ShimCache
FileOverwritten	USN Journal
FileRenamedFrom	USN Journal
FileRenamedTo	USN Journal
FileSecurityChanged	USN Journal
FileTruncated	USN Journal
FileWritten	USN Journal
JumpLists	JumpListFiles
NetworkMap	NetworkMap
RegistryKeyModified	RegistryLoadPoints
Shares	WinShares
SystemStartup	EventLog
USBDriveAttachedDetached	USBDrives
UserLogoff	EventLog
UserLogon	EventLog
WebsiteVisited	ChromeBrowserHistory
	FirefoxBrowserHistory
	IEBrowserHistory