Introduction

File system filter driver

A file system filter driver intercepts requests targeted at a file system or another file system filter driver. By intercepting the request before it reaches its intended target, the filter driver can extend or replace functionality provided by the original target of the request. It is developed primarily to allow the addition of new functionality beyond what is currently available.

File system monitor filter

File system monitor filter can monitor the file system activities on the fly. With file system monitor filter, you can monitor the file activities on file system level, capture file open/create/replace, read/write, query/set file attribute/size/time security information, rename/delete, directory browsing and file close request by which user and process name. You can develop the software for the following purposes:

- Continuous data protection (CDP).
- Auditing.
- Access log.
- Journaling.

File system control filter

File system control filter can control the file activities, which you can intercept the file system call, modify its content before or after the request goes down to the file system, allow/deny/cancel its execution based on the filter rule. You can fully control file open/create/replace, read/write, query/set file attribute/size/time security information, rename/delete, directory browsing these Io requests. With file system control filter, you can developer these kinds of software:

- Data protection.
- File Screening
- Access Control.
- File Security.

The rules to use of file system control filter

To use the file system control filter, you need to follow the following rules, or might cause the system deadlock.

1. *Avoid the re-entrance issue, don't generate any new I/O request which will cause the request comes to the control filter handler again.*
2. *Avoid using any file operations in buffered mode, open any file in the control filter handler with FILE_FLAG_NO_BUFFERING flag set.*
3. *Avoid asynchronous procedure calls.*

4. *Avoid any GUI (user interface) operations.*

File system encryption filter

File system encryption filter provides a comprehensive solution for transparent file level encryption. It allows developers to create transparent, on-access, per-file encryption products which it can encrypt or decrypt file on-the-fly. Our encryption engine uses a strong cryptographic algorithm called Rijndael (256-bit key), it is a high security algorithm created by Joan Daemen and Vincent Rijmen (Belgium). Rijndael is the new Advanced Encryption Standard (AES) chosen by the National Institute of Standards and Technology (NIST).

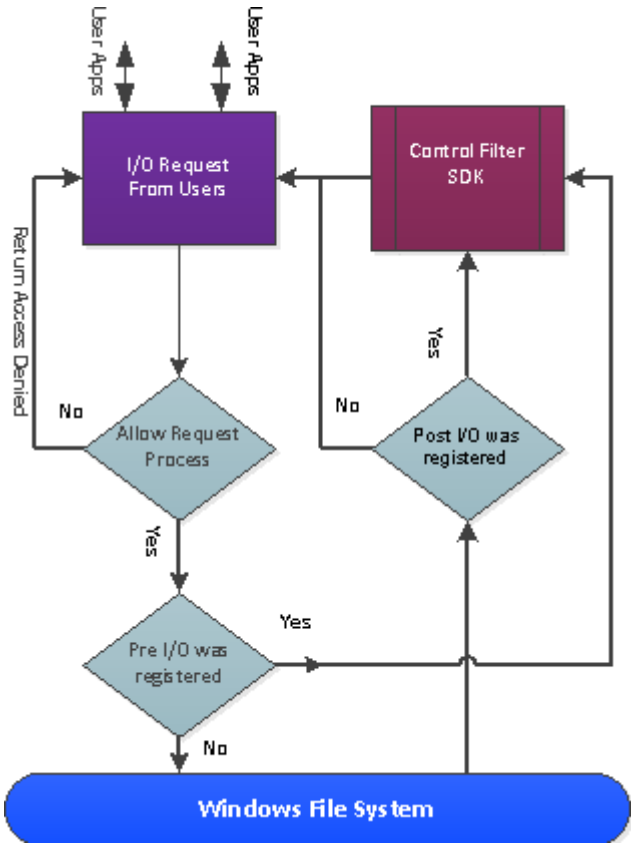
Supported Platforms

- Windows 2016
- Windows 10 (32bit, 64bit)
- Windows 8 (32bit, 64bit)
- Windows 2012 Server R2
- Windows 2008 Server R2 (32bit, 64bit)
- Windows 7 (32bit,64bit)
- Windows 2008 Server (32bit, 64bit)
- Windows Vista (32bit,64bit)
- Windows 2003 Server(32bit,64bit)
- Windows XP(32bit,64bit)

Overview and Basic Concepts

The EaseFilter file system filter driver

EaseFilter file system filter driver is a kernel component module which is sitting on the layer between the I/O manager and the file system. When a user application invokes a win32 API to a file, the filter driver can intercept this I/O, based on the policies was set with the filter rule, the I/O information can be sent to the user, or be modified/blocked the access based on the setting as below figure.



Filter Rule

A filter rule is the policy for the filter driver, it tells the filter driver how to manage the files. To manage the files by filter driver, you need to create at least one filter rule, you can have multiple filter rules with different policies to manage different files to meet your requirement.

A filter rule has only one unique include file mask, when a new filter rule was added to the filter driver, if a filter rule with the same include file filter mask exists, the new filter rule will replace the older one.

A filter rule has a AccessFlags to control if the file access can be proceeded, for Monitor filter driver, it always should be set with the maximum rights. If it is 0, it means this is a exclude filter rule, all the files match the include filter mask will be skipped by this filter rule. Exclude filter rules always are sitting on the top of the other filter rules.

A filter rule can register the file events (reference FileEventType), when it the file I/O events were triggered, the filter driver will send the file events message back to the user mode service.

A filter rule can have multiple exclude file filter masks, it is optional. When a file was opened, if the file name matches the exclude filter mask, the filter driver will skip this file I/O.

A filter rule can have multiple include process names, process Ids, exclude process names, process Ids, include user names and exclude user names. These are optional setting.

If a filter rule has the flag ENCRYPTION_FILTER_RULE enabled, the encrypted data can be decrypted transparently in memory by filter driver when it was read, and the new data will be encrypted and be written to the disk when the encrypted file was written. If the flag ALLOW_NEW_FILE_ENCRYPTION is enabled, the new created file will be encrypted automatically.

If a filter rule has the flag HIDE_FILES_IN_DIRECTORY_BROWSING enabled, the filter rule can add multiple hidden file filter mask, when user browses the folder, if the file names match the hidden filter mask, they will be hidden from the user.

A filter rule only can have one unique include file mask, when a new filter rule was added to the filter driver, if a filter rule with the same include file mask already exists, then the new filter rule will replace the older one. A filter rule can have multiple exclude file masks, multiple include process names and exclude process names, multiple include process Ids and exclude process Ids, multiple include user names and exclude user names.

How to manage the file I/O with the filter rule

When an file I/O occurs, the filter driver will check the filter rule policies with the below order to decide if it should manage this file I/O or not:

a. If the exclude filter rules (AccessFlags is 0) exist, the filter driver will look for all the exclude filter rules first, if the files match the include file filter mask of the exclude filter rule, the filter driver will skip this file I/O, or go to next step.
b. Check the next filter rule, If the file name matches the include file filter mask, then go to next step, or continue step b, till no more filter rules.
c. Check if the exclude file filter mask list is empty, if it is not empty, then it will check if the file name matches the exclude file mask, if it matches, then go to step b, or go to next step.
d. Check if the include process name and include process Id list are empty, if they are not empty, then check if the current process name or process Id is in the include list, if not then go to step b, or go to next step.
e. Check if the exclude process name and exclude process Id list are empty, if they are not empty, then check if the current process name or process Id is in the list, if yes then go to step b, or go to next step.
f. Check if the include user names list is empty, if it is not empty, then check if the current user name is in the list, if not then go to the step b, or go to next step.
g. Check if the exclude user names list is empty, if it is not empty, then check if the current user name is in the list, if yes then go to the step b, or the filter driver will manage this file I/O with this filter rule.

If the files match multiple filter rules, the filter driver will choose the deepest one.

For example:

There are filter rule1 with include file mask c:\test*;
filter rule2 with include file mask c:\test\test2*;
filter rule3 with include file mask c:\test\test2\test3*

the checking order will be rule3, rule2, then rule1.If you have a file with name c:\test\test2\test.txt, the filter driver will choose filter rule 2.

Control filter driver filter rule

For control filter driver, you not only have the same filter rule setting as the monitor filter, but also have the following extra settings:

a. Access control of the filter rule.
b. Access control for specific processes.
c. Access control for specific users.
d. Reparse file open filter rule.
e. Hidden file filter rule.

How to manage the file I/O with the IO registration

Pre-IO and Post IO

A file IO has two steps, pre-IO and post IO. A pre-IO is the I/O process in the filter driver layer, it didn't go down to the file system, a post IO is the I/O process in the filter driver, it already went down to the file system and came back to the filter driver.

You can register the I/O message types (reference MessageType) you are interested, it is a global setting. When a file I/O occurs, if a file name matches a filter rule, and the file I/O was registered, the filter driver will send the I/O message to the user.

A monitor filter driver only can register the post IOs, it means it only can monitor the file I/O result, if a post IO was triggered, the filter driver will send the I/O message to the user and return back right away and won't block and wait.

A control filter driver can register all the IOs, it has the ability to control the file I/O behaviour, it can modify, allow, deny or cancel the file IO and data. When a file IO was triggered, the filter driver will send the I/O message to the user, it will block and wait for the result from the user, the filter driver will go to modify the file I/O and data or not based on the return result.

An I/O message

A typical I/O message includes the file I/O type, file name, file information (file size, file attribute, file time), user name, process name and the I/O result for the post I/O.

Symbol Reference

Structures, Enums

Typedef enum FilterType

```
{
    FILE_SYSTEM_MONITOR                 = 0,
    FILE_SYSTEM_CONTROL                 = 1,
    FILE_SYSTEM_ENCRYPTION              = 2,
    FILE_SYSTEM_CONTROL_ENCRYPTION      = 3,
    FILE_SYSTEM_MONITOR_ENCRYPTION      = 4,
    FILE_SYSTEM_EASE_FILTER_ALL         = 5,
    FILE_SYSTEM_MONITOR_CONTROL         = 8,
};
```

Comments

FILE_SYSTEM_MONITOR filter type is the file system filter driver which only intercept the file I/O notification after it was completed.

FILE_SYSTEM_CONTROL filter type is the file system filter driver which can control the file I/O request's behaviour before it goes down to the file system or after it is completed by the file system.

FILE_SYSTEM_ENCRYPTION filter type is the file system filter driver which can encrypt and decrypt the files on-the-fly.

FILE_SYSTEM_CONTROL_ENCRYPTION filter type includes both control filter and encryption filter driver.

FILE_SYSTEM_MONITOR_ENCRYPTION filter type includes both monitor filter and encryption filter driver.

FILE_SYSTEM_EASE_FILTER_ALL filter type includes monitor filter,control filter and encryption filter driver.

FILE_SYSTEM_MONITOR_CONTROL filter type includes both monitor filter and control filter driver.

typedef enum FileEventType

```
{
     FILE_WAS_CREATED                   = 0x00000020,
     FILE_WAS_WRITTEN                   = 0x00000040,
```

```
    FILE_WAS_RENAMED                = 0x00000080,
    FILE_WAS_DELETED                = 0x00000100,
    FILE_SECURITY_CHANGED           = 0x00000200,
    FILE_INFO_CHANGED               = 0x00000400,
    FILE_WAS_READ                   = 0x00000800,
};
```

Members

FILE_WAS_CREATED

The new file was created event.

FILE_WAS_WRITTEN

The file was written with data event.

FILE_WAS_RENAMED

The file was renamed event.

FILE_SECURITY_CHANGED

The file security was changed event.

FILE_INFO_CHANGED

The file information was changed event.

FILE_WAS_READ

The file data was read event.

Comments

This is the registered event types of the filter rule, monitor the file events which only happens in the filter rule.

typedef enum MessageType

```
{
    PRE_CREATE                          = 0x00000001,
    POST_CREATE                         = 0x00000002,
    PRE_FASTIO_READ                     = 0x00000004,
    POST_FASTIO_READ                    = 0x00000008,
```

```
    PRE_CACHE_READ                          = 0x00000010,
    POST_CACHE_READ                         = 0x00000020,
    PRE_NOCACHE_READ                        = 0x00000040,
    POST_NOCACHE_READ                       = 0x00000080,
    PRE_PAGING_IO_READ                      = 0x00000100,
    POST_PAGING_IO_READ                     = 0x00000200,
    PRE_FASTIO_WRITE                        = 0x00000400,
    POST_FASTIO_WRITE                       = 0x00000800,
    PRE_CACHE_WRITE                         = 0x00001000,
    POST_CACHE_WRITE                        = 0x00002000,
    PRE_NOCACHE_WRITE                       = 0x00004000,
    POST_NOCACHE_WRITE                      = 0x00008000,
    PRE_PAGING_IO_WRITE                     = 0x00010000,
    POST_PAGING_IO_WRITE                    = 0x00020000,
    PRE_QUERY_INFORMATION                   = 0x00040000,
    POST_QUERY_INFORMATION                  = 0x00080000,
    PRE_SET_INFORMATION                     = 0x00100000,
    POST_SET_INFORMATION                    = 0x00200000,
    PRE_DIRECTORY                           = 0x00400000,
    POST_DIRECTORY                          = 0x00800000,
    PRE_QUERY_SECURITY                      = 0x01000000,
    POST_QUERY_SECURITY                     = 0x02000000,
    PRE_SET_SECURITY                        = 0x04000000,
    POST_SET_SECURITY                       = 0x08000000,
    PRE_CLEANUP                             = 0x10000000,
    POST_CLEANUP                            = 0x20000000,
    PRE_CLOSE                               = 0x40000000,
    POST_CLOSE                              = 0x80000000,

};
```

Members

PRE_CREATE

PRE_CREATE request is the create I/O request before it goes down to the file system.

POST_CREATE

POST_CREATE request is the create I/O request after it is completed by file system.

PRE_FASTIO_READ

PRE_FASTIO_READ is the read I/O request before it goes to the Cache Manager.

POST_FASTIO_READ

POST_FASTIO_READ is the read I/O request after it comes back from the Cache Manager.If the data is not in the Cache Manager,it will return false,and the I/O Manager will reissue a new request to the file system.

PRE_CACHE_READ

PRE_CACHE_READ is the read I/O request with data cache before it goes to the Cache Manager.

POST_CACHE_READ

POST_CACHE_READ is the read I/O request after it come back from Cache Manager.If the data is not in the Cache Manager, it will trigger a paging I/O read request and load the data from the storage to the Cache Manager.Normally you will see the paging I/O read request follows the cache read request.

PRE_NONCACHE_READ

PRE_NONCACHE_READ is the read I/O request without data cache before it goes to the file system.

POST_NONCACHE_READ

POST_NONCACHE_READ is the read I/O request after it comes back from the file system.The data won't cache in the Cache Manager. You will see the noncache read request if you open a file and specify FILE_NO_INTERMEDIATE_BUFFERING.

PRE_PAGING_IO_READ

PRE_PAGING_IO_READ is the read I/O request before it goes to the file system.It is initiated by the virtual memory system in order to satisfy the needs of the demand paging system.

POST_PAGING_IO_READ

POST_PAGING_IO_READ is the read I/O request after it come back from file system.For memory mapping file open you will see this request without the cache read request, for example open file with notepad application.

PRE_FASTIO_WRITE

PRE_FASTIO_WRITE is the write I/O request before it writes to the Cache Manager.

POST_FASTIO_WRITE

POST_FASTIO_WRITE is the write I/O request after it wrote to the Cache Manager. Normally you will see the paging I/O write request follows the fast I/O write request.

PRE_CACHE_WRITE

PRE_CACHE_WRITE is the write I/O request with data cache before it writes to the Cache Manager.

POST_CACHE_WRITE

POST_CACHE_WRITE is the write I/O request after it wrote to the Cache Manager. Normally you will see the paging I/O write request follows the cache write request.

PRE_NONCACHE_WRITE

PRE_NONCACHE_WRITE is the write I/O request without data cache before it wrote to the storage by the file system.

POST_NONCACHE_WRITE

POST_NONCACHE_WRITE is the write I/O request after it comes back from the file system.The data won't cache in the Cache Manager. You will see the noncache write request if you open a file and specify FILE_NO_INTERMEDIATE_BUFFERING.

PRE_PAGING_IO_WRITE

PRE_PAGING_IO_WRITE is the write I/O request on behalf of the Virtual Manager system before it writes to the storage by the file system.

POST_PAGING_IO_WRITE

POST_PAGING_IO_WRITE is the write I/O request after it come back from file system.

PRE_QUERY_INFORMATION

PRE_QUERY_INFORMATION is the I/O request which retrives information for a given file before it goese down to the file system. The file information class tells the type of the information will be returned.

POST_QUERY_INFORMATION

POST_QUERY_INFORMATION is the I/O request which retrives information for a given file after it comes back from the file system. The file information class tells the type of the information will be returned.

PRE_SET_INFORMATION

PRE_SET_INFORMATION is the I/O request which set information for a given file before it goese down to the file system. The file information class tells the type of the information will be set.

POST_SET_INFORMATION

POST_SET_INFORMATION is the I/O request which set information for a given file after it comes back from the file system. The file information class tells the type of the information will be set.

PRE_DIRECTORY

PRE_DIRECTORY is the folder browsing I/O request before it goese down to the file system. It retrive various kinds of information about files in the given directory. The information class tells the type of information will be returned.

POST_DIRECTORY

POST_DIRECTORY is the folder browsing I/O request after it comes back from the file system. It retrive various kinds of information about files in the given directory. The information class tells the type of information will be returned.

PRE_QUERY_SECURITY

PRE_QUERY_SECURITY is the query security request before it goes down to the file system. It will retrive the security descriptor for a given file. The security information tells the the type of the security descriptor.

POST_QUERY_SECURITY

POST_QUERY_SECURITY is the query security request after it comes back from the file system. It will retrive the

security descriptor for a given file. The security information tells the the type of the security descriptor.

PRE_SET_SECURITY

PRE_SET_SECURITY is the set security request before it goes down to the file system. It will set the security state for a given file. The security information tells the the type of the security descriptor.

POST_SET_SECURITY

POST_SET_SECURITY is the set security request after it comes back from the file system. It will set the security state for a given file. The security information tells the the type of the security descriptor.

PRE_CLEANUP

PRE_CLEANUP is the cleanup request before it goes down to the file system. It indicates that the handle reference count on a file object has reached zero. In other words, all handles to the file object have been closed. Often it is sent when a user-mode application has called the Microsoft Win32 CloseHandle function on the last outstanding handle to a file object.

POST_CLEANUP

POST_QUERY_SECURITY is the cleanup request after it comes back from the file system.

PRE_CLOSE

PRE_CLOSE is the close request before it goese down to the file system. It indicates that the reference count on a file object has reached zero, usually because a file system driver or other kernel-mode component has called ObDereferenceObject on the file object. This request normally follows a cleanup request. However, this does not necessarily mean that the close request will be received immediately after the cleanup request.

POST_CLOSE

POST_CLOSE is the close request after it comes back from the file system.

Comments

Register the I/O request with the combination of the request type you want to monitor. For file system monitor filter, only post requests are affected.

typedef enum AccessFlag

```
{
  EXCLUDE_FILTER_RULE                          = 0X00000000,
  EXCLUDE_FILE_ACCESS                          = 0x00000001,
  REPARSE_FILE_OPEN                            = 0x00000002,
  HIDE_FILES_IN_DIRECTORY_BROWSING             = 0x00000004,
  FILE_ENCRYPTION_RULE                         = 0x00000008,
  ALLOW_OPEN_WTIH_ACCESS_SYSTEM_SECURITY       = 0x00000010,
  ALLOW_OPEN_WITH_READ_ACCESS                  = 0x00000020,
  ALLOW_OPEN_WITH_WRITE_ACCESS                 = 0x00000040,
  ALLOW_OPEN_WITH_CREATE_OR_OVERWRITE_ACCESS = 0x00000080,
  ALLOW_OPEN_WITH_DELETE_ACCESS                = 0x00000100,
  ALLOW_READ_ACCESS                            = 0x00000200,
  ALLOW_WRITE_ACCESS                           = 0x00000400,
  ALLOW_QUERY_INFORMATION_ACCESS               = 0x00000800,
  ALLOW_SET_INFORMATION                        = 0x00001000,
  ALLOW_FILE_RENAME                            = 0x00002000,
  ALLOW_FILE_DELETE                            = 0x00004000,
  ALLOW_FILE_SIZE_CHANGE                       = 0x00008000,
  ALLOW_QUERY_SECURITY_ACCESS                  = 0x00010000,
  ALLOW_SET_SECURITY_ACCESS                    = 0x00020000,
  ALLOW_DIRECTORY_LIST_ACCESS                  = 0x00040000,
  ALLOW_FILE_ACCESS_FROM_NETWORK               = 0x00080000,
  ALLOW_NEW_FILE_ENCRYPTION                    = 0x00100000,
  ALLOW_READ_ENCRYPTED_FILES                   = 0x00200000,
  ALLOW_ALL_SAVE_AS                            = 0x00400000,
  ALLOW_COPY_PROTECTED_FILES_OUT               = 0x00800000,
  ALLOW_FILE_MEMORY_MAPPED                     = 0x01000000,
  ALLOW_MAX_RIGHT_ACCESS                       = 0xfffffff0,

};
```

Members

EXCLUDE_FILTER_RULE

EXCLUDE_FILTER_RULE is the rule which bypass the files matched the FilterMask. It can`t combine to use with the other access flags. If a file matchs the exclude filter rule,the filter will bypass this file,you won`t get any Io request notification or control. If a file

matches both the exclude filter rule and monitor rule, the exclude filter rule will be applied.

EXCLUDE_FILE_ACCESS

EXCLUDE_FILE_ACCESS is the flag indicates the filter will deny the access to the files which match the FilterMask.

REPARSE_FILE_OPEN

REPARSE_FILE_OPEN is the rule which reparses the file matched the FilterMask open to the other files which match the ReparseMask.

Example:

AddFilterRule (REPARSE_FILE_OPEN,L"c:\\test",L"d:\\reparse*");*

All the open request to the files in the folder c:\test will reparse to the files in the folder d:\reparse.

HIDE_FILES_IN_DIRECTORY_BROWSING

HIDE_FILES_IN_DIRECTORY_BROWSING is the flag let you hide the files in the managed folder when it matches the mask.

Example:

AddFilterRule (ALLOW_MAX_RIGHT_ACCESS|HIDE_FILES_IN_DIRECTORY_BROWSING,L"c:\\test",L"*.txt");*

When you browse the folder c:\test, all the files with extension ".txt" will be hidden.

ENCRYPTION_FILTER_RULE

ENCRYPTION_FILTER_RULE is the flag indicates the filter will encrypt the new created files which match the FilterMask.If the other flag were set, this flag is automatically enabled.

ALLOW_OPEN_WTIH_ACCESS_SYSTEM_SECURITY

ALLOW_OPEN_WTIH_ACCESS_SYSTEM_SECURITY is the flag indicates if you can open the file with the desired access with the ACCESS_SYSTEM_SECURITY set.

ALLOW_OPEN_WITH_READ_ACCESS

ALLOW_OPEN_WITH_READ_ACCESS is the flag indicates if you can open the file with read access.

ALLOW_OPEN_WITH_WRITE_ACCESS

ALLOW_OPEN_WITH_WRITE_ACCESS is the flag indicates if you can open the file with write access.

ALLOW_OPEN_WITH_CREATE_OR_OVERWRITE_ACCESS

ALLOW_OPEN_WITH_CREATE_OR_OVERWRITE_ACCESS is the flag indicates if you can open with create a new file or overwrite the exist file.

ALLOW_OPEN_WITH_DELETE_ACCESS

ALLOW_OPEN_WITH_DELETE_ACCESS is the flag indicates if you can open the file for deletion or rename access.

ALLOW_READ_ACCESS

ALLOW_READ_ACCESS is the flag indicates if you have the permission to read the file.

ALLOW_WRITE_ACCESS

ALLOW_WRITE_ACCESS is the flag indicates if you have the permission to write the file.

ALLOW_QUERY_INFORMATION_ACCESS

ALLOW_QUERY_INFORMATION_ACCESS is the flag indicates if you have the permission to query the file information.

ALLOW_SET_INFORMATION

ALLOW_SET_INFORMATION is the flag indicates if you have the permission to set the file information.

ALLOW_FILE_RENAME

ALLOW_FILE_RENAME is the flag indicates if you have the permission to rename the file. If the flag ALLOW_SET_INFORMATION is unset, the rename is blocked automatically.

ALLOW_FILE_DELETE

ALLOW_FILE_DELETE is the flag indicates if you have the permission to delete the file. If the flag ALLOW_SET_INFORMATION is unset, the deletion is blocked automatically.

ALLOW_FILE_SIZE_CHANGE

ALLOW_FILE_SIZE_CHANGE is the flag indicates if you have the permission to change the file size. If the flag ALLOW_SET_INFORMATION is unset, the file size chage is blocked automatically.

ALLOW_QUERY_SECURITY_ACCESS

ALLOW_QUERY_SECURITY_ACCESS is the flag indicates if you have the permission to query the file security.

ALLOW_SET_SECURITY_ACCESS

ALLOW_SET_SECURITY_ACCESS is the flag indicates if you have the permission to set the file security.

ALLOW_DIRECTORY_LIST_ACCESS

ALLOW_DIRECTORY_LIST_ACCESS is the flag indicates if you have the permission to browse the directory.

ALLOW_FILE_ACCESS_FROM_NETWORK

ALLOW_FILE_ACCESS_FROM_NETWORK is the flag indicates if you have the permission to access the files from the network server.

ALLOW_NEW_FILE_ENCRYPTION

ALLOW_NEW_FILE_ENCRYPTION is the flag indicates if you allow to encrypt the new created files by the filter driver.

ALLOW_READ_ENCRYPTED_FILES

ALLOW_READ_ENCRYPTED_FILES is the flag indicates if you allow to read encrypted files, if it is disabled, the encrypted data will return to the users.

ALLOW_ALL_SAVE_AS

ALLOW_ALL_SAVE_AS is the flag indicates if the process has the permission to create a new file.

ALLOW_COPY_PROTECTED_FILES_OUT

ALLOW_COPY_PROTECTED_FILES_OUT is the flag indicates if allow the protected files being copy out of the protected folder, if allow_all_save_as is true.

ALLOW_FILE_MEMORY_MAPPED

ALLOW_FILE_MEMORY_MAPPED indicates if the file can be opened with memory mapped, a file excution must be opened with memory mapped.

ALLOW_MAX_RIGHT_ACCESS

ALLOW_MAX_RIGHT_ACCESS indicates if you have the maximum access right to the file.

Comments

A accessFlag is associated to a filter rule, used to control the access to the files matched the FilterMask.

typedef enum AESFlags

```
{
  Flags_Enabled_Expire_Time                 = 0x00000010,
  Flags_Enabled_Check_ProcessName           = 0x00000020,
  Flags_Enabled_Check_UserName              = 0x00000040,
  Flags_Enabled_Check_AccessFlags           = 0x00000080,
  Flags_Enabled_Check_User_Permit           = 0x00000100,
  Flags_AES_Key_Was_Embedded                = 0x00000200,
  Flags_Enabled_Request_IV_And_Key          = 0x00000400,
  Flags_Enabled_Revoke_Access_Control       = 0x00000800,
  Flags_Enabled_Check_Computer_Id           = 0x00001000,
  Flags_Enabled_Check_User_Password         = 0x00002000,
```

```
};
```

Members

Flags_Enabled_Expire_Time

Flags_Enabled_Expire_Time is the flag which indicates that the filter driver will check if the encrypted file was expired before it can be opened.

Flags_Enabled_Check_ProcessName

Flags_Enabled_Check_ProcessName is the flag which indicates that the filter driver will check if the process has the permission to open the encrypted file.

Flags_Enabled_Check_UserName

Flags_Enabled_Check_UserName is the flag which indicates that the filter driver will check if the user has the permission to open the encrypted file.

Flags_Enabled_Check_AccessFlags

Flags_Enabled_Check_AccessFlags is the flag which indicates that the filter driver will check the access flags if the encrypted file can be opened.

Flags_Enabled_Check_User_Permit

Flags_Enabled_Check_User_Permit is the flag which indicates that the filter driver will require the user permission before the encrypted file can be opened.

Flags_AES_KEY_WAS_EMBEDDED

Flags_AES_KEY_WAS_EMBEDDED is the flag which indicates that the filter driver will user the embedded AES key to decrypt the file.

Flags_Enabled_Request_IV_And_Key

Flags_Enabled_Request_IV_And_Key is the flag which indicates that the filter driver will require encryption key and IV from user mode service to decrypt the file.

Flags_Enabled_Revoke_Access_Control

Flags_Enabled_Revoke_Access_Control is the flag which indicates that the filter driver will require the permission from the control server and get the encryption key and IV to decrypt the file.

Flags_Enabled_Check_Computer_Id

Flags_Enabled_Check_Computer_Id is the flag which indicates that the filter driver will check if the computer can access the encrypted files.

Flags_Enabled_Check_User_Password

Flags_Enabled_Check_User_Password is the flag which indicates that the filter driver will require the user password before the encrypted file can be opened.

Comments

A AESFlags is a flag inside the metadata of the encrypted file.

typedef struct _EASETAG_AES_DATA

```
{
    ULONG       EaseTagKey;
    ULONG       AESFlags;
    ULONG       IVLength;
    UCHAR       IV[16];
    ULONG       EncryptionKeyLength;
    UCHAR       EncryptionKey[32];
    LONGLONG    CreationTime;
    LONGLONG    ExpireTime;
    ULONG       AccessFlags;
    LONGLONG    FileSize;
    ULONG       LengthOfIncludeProcessNames;
    ULONG       OffsetOfIncludeProcessNames;
    ULONG       LengthOfExcludeProcessNames;
    ULONG       OffsetOfExcludeProcessNames;
    ULONG       LengthOfIncludeUserNames;
    ULONG       OffsetOfIncludeUserNames;
    ULONG       LengthOfExcludeUserNames;
    ULONG       OffsetOfExcludeUserNames;
    ULONG       LengthOfAccountName;
    ULONG       OffsetOfAccountName;
    ULONG       LengthOfComputerId;
```

```
        ULONG       OffsetOfComputerId;
        ULONG       LengthOfUserPassword;
        ULONG       OffsetOfUserPassword;
        //the data store here.
        //IncludeProcessNames;
        //ExcludeProcessNames;
        //IncludeUserNames;
        //ExcludeUserNames;
        //AccountName;
        //ComputerId;
        //UserPassword;
        ULONG       TotalSizeOfAESData;

}
```

Members

EaseTagKey

The verification key of the AES data structure, the value is 0xccb76e80.

AESFlags

The Flags of the encrypted file's meta data,indicates the filter driver what action needs to do for the encrypted file opens.

IVLength

The length of the initialization vector, it should be 16.

IV

The 16 bytes initialization vector, is an arbitrary number that can be used along with an encryption key for the file encryption.

EncryptionKeyLength

The length of the encryption key, it should be 16,24 or 32.

EncryptionKey

The encryption key for the file encryption.

CreationTime

The date and time of the encrypted file was created.

ExpireTime

The expiration time of the encrypted file.

Accesslags

The access flags of the encrypted file, control the access of the encrypted file if Flags_Enabled_Check_AccessFlags is enabled, reference the AccessFlag enumeration.

FileSize

The file size of the encrypted file.

LengthOfIncludeProcessNames

The length of the include process name string,if the flag Flags_Enabled_Check_ProcessName is enabled,only the inlcuded processes which were stored the include process name buffer can access the encrypted files.

OffsetOfIncludeProcessNames

The offset of the include process name string buffer from the beginning of the structure.

LengthOfExcludeProcessNames

The length of the exclude process name string,if the flag Flags_Enabled_Check_ProcessName is enabled,only the exlcuded processes which were stored the exclude process name buffer can't access the encrypted files.

OffsetOfExcludeProcessNames

The offset of the exclude process name string buffer from the beginning of the structure.

LengthOfIncludeUserNames

The length of the include user name string,if the flag Flags_Enabled_Check_UserName is enabled,only the inlcuded useres which were stored the include user name buffer can access the encrypted files.

OffsetOfIncludeProcessNames

The offset of the include user name string buffer from the beginning of the structure.

LengthOfExcludeUserNames

The length of the exclude user name string,if the flag Flags_Enabled_Check_UserName is enabled,only the exlcuded users which were stored the exclude user name buffer can't access the encrypted files.

OffsetOfExcludeUserNames

The offset of the exclude user name string buffer from the beginning of the structure.

LengthOfAccountName

The length of the account name in the server which identifies the user.

OffsetOfAccountName

The offset of the account name buffer from the beginning of the structure.

LengthOfComputerId

The length of the computer Id string, if the flag Flags_Enabled_Check_Computer_Id is enabled, only the computers match the computer Id string can access the encrypted file.

OffsetOfComputerId

The offset of the computer Id string buffer from the beginning of the structure.

LengthOfUserPassword

The length of the user password,if the flag Flags_Enabled_Check_Password is enabled,it requires the user to input the password. The filter driver can open the encrypted file only when the correct password was input.

OffsetOfUserPassword

The offset of the user password buffer from the beginning of the structure.

IncludeProcessNames

The buffer of the include process name string buffer if the LengthOfIncludeProcessNames is greater than 0, the multiple process names are seperated with character ';'.

ExcludeProcessNames

The buffer of the exclude process name string buffer if the LengthOfExcludeProcessNames is greater than 0, the multiple process names are seperated with character ';'.

IncludeUserNames

The buffer of the include user name string buffer if the LengthOfIncludeUserNames is greater than 0, the multiple user names are seperated with character ';'.

ExcludeUserNames

The buffer of the exclude user name string buffer if the LengthOfExcludeUserNames is greater than 0, the multiple user names are seperated with character ';'.

AccountName

The buffer of the account name string buffer if the LengthOfAccountName is greater than 0.

ComputerIds

The buffer of the computer Id string buffer if the LengthOfComputerId is greater than 0, the multiple computer Ids are seperated with character ';'.

UserPassword

The buffer of the password buffer if the LengthOfUserPassword is greater than 0.

TotalSizeOfAESData

The total size of the structure EASETAG_AES_DATA.

Comments

EASETAG_AES_DATA structure is the metadata of the encrypted file, includes the access control information if Flags_Enabled_Revoke_Access_Control is not enabled, or the access control information was stored in the remote server.

Typedef enum FilterStatus

```
{
     FILTER_MESSAGE_IS_DIRTY              = 0x00000001,
     FILTER_COMPLETE_PRE_OPERATION        = 0x00000002,
     FILTER_DATA_BUFFER_IS_UPDATED        = 0x00000004,
};
```

Members

FILTER_MESSAGE_IS_DIRTY

FILTER_MESSAGE_IS_DIRTY is the flag indicates the reply message was modified and needs to be processed in filter driver. Set this flag if you change the reply message.

FILTER_COMPLETE_PRE_OPERATION

FILTER_COMPLETE_PRE_OPERATION is the flag indicates the filter needs to complete this pre I/O request.Only set this flag with pre operation request when you don`t want the request goes down to the file system.

FILTER_DATA_BUFFER_IS_UPDATED

FILTER_DATA_BUFFER_IS_UPDATED is the flag indicates the data buffer of the reply message was updated.The filter will process this data buffer.

Comments

FitlerStatus is the status code which returns to the filter driver,it is for control filter driver.It instructs the filter drive what action needs to be done.

typedef struct _MESSAGE_SEND_DATA

```
{
     ULONG               MessageId;
     PVOID               FileObject;
```

```
    PVOID               FsContext;
    ULONG               MessageType;
    ULONG               ProcessId;
    ULONG               ThreadId;
    LONGLONG            Offset;
    ULONG               Length;
    LONGLONG            FileSize;
    LONGLONG            TransactionTime;
    LONGLONG            CreationTime;
    LONGLONG            LastAccessTime;
    LONGLONG            LastWriteTime;
    ULONG               FileAttributes;
    ULONG               DesiredAccess;
    ULONG               Disposition;
    ULONG               ShareAccess;
    ULONG               CreateOptions;
    ULONG               CreateStatus;
    ULONG               InfoClass;
    ULONG               Status;
    ULONG               FileNameLength;
    WCHAR               FileName[MAX_FILE_NAME_LENGTH];
    ULONG               SidLength;
    UCHAR               Sid[MAX_SID_LENGTH];
    ULONG               DataBufferLength;
    UCHAR               DataBuffer[MAX_MESSAGE_SIZE];
    ULONG               VerificationNumber;

} MESSAGE_SEND_DATA, *PMESSAGE_SEND_DATA;
```

Members

MessageId

This is the sequential number of the transaction.

FileObject

The FileObject is the pointer to the file object,it is a unique number to every file open.

FsContext

The FsContext is the pointer to the file context,it is unique number to the same file.

MessageType

MessageType is the I/O request type for this transaction.

ProcessId

The ProcessId is the id of the process associated with the thread that originally requested the I/O operation.

ThreadId

The ThreadId is the id of thread which requested the I/O operation.

Offset

The Offset is the read or write offset.

Length

The Length is the length for read or write.

FileSize

The FileSize is the size of the file for this I/O request.

TransactionTime

The transaction time in UTC format of the request.

CreationTime

The creation time in UTC format of the file we are requesting.

LastAccessTime

The last access time in UTC format of the file we are requesting.

LastWriteTime

The last write time in UTC format of the file we are requesting.

FileAttributes

The file attributes of the file we are requesting.

DesiredAccess

The DesiredAccess is the request access to the file for the Create I/O request,which can be summarized as read,write,both or neither zero.For more information reference the Windows API CreateFile.

Disposition

The disposition is the action to take on a file that exist or does not exist. For more information reference the Windows API CreateFile.

SharedAccess

The SharedAccess is the requested sharing mode of the file which can be read,write,both,delete,all of these,or none. For more information reference the Windows API CreateFile.

CreateOptions

The CreateOptions specifies the options to be applied when creating or opening the file. For more information reference the Windows API CreateFile.

CreateStatus

The CreateStatus is the status after the Create I/O request completed.It could be the one of the following values:

```
FILE_SUPERSEDED = 0x00000000,
FILE_OPENED = 0x00000001,
FILE_CREATED = 0x00000002,
FILE_OVERWRITTEN = 0x00000003,
FILE_EXISTS = 0x00000004,
FILE_DOES_NOT_EXIST = 0x00000005,
```

InfoClass

The infoClss is the information class for query/set information I/O request, or directory browsing request. For query/set security request, it is the security information.For more information reference the windows Filter API FltQueryInformationFile, FltQueryDirectoryFile,FltQuerySecurityObject.

Status

The Status is the I/O status which returns from the file system,indicates if the I/O request succeeded.It is only meaningful to the post I/O requests.

FileNameLength

The file name length in byte of the file we are requesting.

FileName

The file name we are requesting.

SidLength

The length of the security identifier buffer in byte.

Sid

The buffer of the security identifier data.

DataBufferLength

The data buffer length for read, write, security, information,directory I/O requests.

DataBuffer

The The data buffer length for read, write, security, information, directory I/O requests.

VerificationNumber

The verification number to verify the data structure integerity.

Comments

The MESSAGE_SEND_DATA structure is used to transfer the data from kernel to the user mode application. It includes all the information needed for the user.

typedef struct _MESSAGE_REPLY_DATA

```
{
    ULONG           MessageId;
    ULONG           MessageType;
    ULONG           ReturnStatus;
    ULONG           FilterStatus;
    union
    {
    Struct{
                    ULONG     DataBufferLength;
                    UCHAR     DataBuffer[MAX_MESSAGE_SIZE];
          }Data;

    Struct{
                    ULONG     AESDataLength;
                    UCHAR     IV[16];
                    ULONG     EncryptionKeyLength;
                    UCHAR     EncryptionKey[1];
          }AESData;

    Struct{
                    ULONG     UserNameLength;
                    UCHAR     UserName[1];
          }UserInfo;

    Struct{
```

```
                    ULONG     FileNameLength;
                    UCHAR     FileName[1];
            }FileInfo;

      }ReplyData

} MESSAGE_REPLY_DATA, *PMESSAGE_REPLY_DATA;
```

Members

MessageId
This is the sequential number of the transaction.

MessageType
MessageType is the I/O request type for this transaction. Reference MessageType enum type.

ReturnStatus
The ReturnStatus is the I/O status which returns to filter driver, and filter will return this status to the user application for the request.

FilterStatus
The FitlerStatus is the status code which returns to the filter driver,it instructs the filter what process needs to be done. For more information reference the FilterStatus enum.

DataBufferLength
The data buffer length which returns to the filter driver.

DataBuffer
The data buffer which returns to the filter driver.

AESDataLength
The total length of the AESData.

IV
The 16 bytes initialization vector returns to filter driver.

EncryptionKeyLength
The length of the encryption key.

EncrytionKey
The encrytion key returns to the filter driver.

UserNameLength
The length of the user name.

UserName
The user name buffer.

FileNameLength
The length of the file name.

FileName
The file name buffer.

Comments

MESSAGE_REPLY_DATA is only for control filter, when it needs to change the data or status of the I/O request. To update the reply data buffer, you must understand the format of the buffer, incorrect data could cause your system unfunctional, even crash.

Types

typedef BOOL (_stdcall *Proto_Message_Callback)(

```
IN     PMESSAGE_SEND_DATA  pSendMessage,
IN OUT PMESSAGE_REPLY_DATA pReplyMessage)
```

Comments

This is the proto type of the message callback function. The function will be called when the registed I/O requests match the filter rule. The second parameter "pReplyMessage" is always NULL for the file system monitor filter.

typedef VOID (_stdcall *Proto_Disconnect_Callback)()

Comments

This is the proto type of disconnect function.The function will be called when the connection to the filter is disconnected.

Exported API

BOOL

InstallDriver()

Return Value

Return true if it succeeds, else return false.

Comments

Install the EaseFilter driver to the system.To install the driver you need the administrator permission.

BOOL

UnInstallDriver()

Return Value

Return true if it succeeds, else return false.

Comments

UnInstall the EaseFilter driver from the system. To UnInstall the driver you need the administrator permission.

BOOL

SetRegistrationKey(

IN WCHAR RegisterKey)*

Parameters

RegisterKey

Your register key.

Return Value

Return true if it succeeds, else return false.

Comments

You have to set the registration key before you can start the filter.

BOOL

RegisterMessageCallback(

ULONG ThreadCount,
Proto_Message_Callback MessageCallback,
Proto_Disconnect_Callback DisconnectCallback)

Parameters

ThreadCount
The number of threads used for connection to the filter.

MessageCallback
The message callback function for the registered I/O requests.

DisconnectCallback
The disconnect callback function when the connection is disconnected.

Return Value
Return true if it succeeds, else return false.

Comments

RegisterMessageCallback is the first API you need to call, it is the API start the filter and create the connection to the filter.

VOID

Disconnect()

Comments

Disconnect is the API when you want to stop filter and filter connection.

BOOL

GetLastErrorMessage(WCHAR Buffer, PULONG BufferLength)*

Parameters

Buffer

This the pointer of the buffer to receive the last error message.

BufferLength

The length of the buffer.

Return Value

Return true if it succeeds,else return false if the buffer length is not big enough to contain the message,and the BufferLength is set with the right size needed.

Comments

This API is called right after if the other API is failed. It will return the error message.

BOOL

ResetConfigData();

Return Value

Return true if it succeeds, else return false.

Comments

ResetConfigData is the API reset all the configuration of the filter, it will clear up all the setting includes the filter rules.

BOOL

SetFilterType(ULONG FilterType)

Parameters

FilterType

The type of the filter you want to set. There are FILE_SYSTEM_MONITOR filter and FILE_SYSTEM_CONTROL filter.

Return Value

Return true if it succeeds, else return false.

Comments

The default filter type is file system monitor filter.

BOOL

SetConnectionTimeout(ULONG TimeOutInSeconds)

Parameters

TimeOutInSeconds
The value of the filter wait time out.

Return Value
Return true if it succeeds, else return false.

Comments

This is the maixmum time for the filter driver wait for the response from user mode, the user mode application should return as fast as possible, or it will block the system requests.Set it bigger if your application needs to process with more time.

BOOL

AddNewFilterRule(

```
    IN   ULONG  AccessFlag,
    IN   WCHAR* FilterMask
)
```

Parameters

AccessFlag
The AccessFlag of this filter rule.

FilterMask
The FilterMask set the target folder or files.The mask is dos format,it can include wild character '*'or '?'. For example:

C:\test*txt
The filter only monitor the files end with 'txt' in the folder c:\test.

Return Value
Return true if it succeeds, else return false.

Comments

AddNewFilterRule is the API to setup the filter rule,You can set up multiple filte rules, the FilterMask must be different, if the FilterMask is the same, it will overwrite the previous one.

BOOL

RegisterEventTypeToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG  EventType
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

EventType
The event types were registered to the filter rule, were used to monitor the file events.

Comments

If you want to monitor the file events for the filter rule, this is the API to register the event types.

BOOL

RegisterMonitorToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG  RegisterIO
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

RegisterIO
The IOs were registered to the filter rule,only post-IOs can be registered, it was used to monitor the file IOs, when it was triggered, filter driver will send the notification to the user.

Comments

If you want to get the notification of the file IOs for the filter rule, this is the API to register the IOs which you are interested.

BOOL

RegisterControlToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG  RegisterIO
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

RegisterIO
The IOs were registered to the filter rule, were used to control the file IOs, when it was triggered, filter driver will send the notification to the user, block and wait for the response, it can control the IOs data and status based on the return result.

Comments

If you want to control the file requests, this is the API to register the IOs which you are interested.

BOOL

AddEncryptionKeyToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG  EncryptionKeyLength,
    IN   UCHAR* EncryptionKey
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

EncryptionKeyLength
The length of the encryption key.

EncryptionKey
The encryption key for the filter rule.

Return Value

Return true if it succeeds, else return false.

Comments

If the encryption was enabled in the access flag in the API AddNewFilterRule, this is the API to add the encryption key for the filter rule, every file will use an unique iv.

BOOL

AddEncryptionKeyAndIVToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG  EncryptionKeyLength,
    IN   UCHAR* EncryptionKey,
    IN   ULONG  IVLength,
    IN   UCHAR* IV
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

EncryptionKeyLength

The length of the encryption key.

EncryptionKey

The encryption key for the filter rule.

IVLength

The length of the encryption iv.

IV

The encryption iv for the filter rule.

Return Value

Return true if it succeeds, else return false.

Comments

If the encryption was enabled in the access flag in the API AddNewFilterRule, this is the API to add the encryption key and iv for the filter rule, all files in this filter rule will use the same key and iv.

BOOL

AddReparseFileMaskToFilterRule(

```
     IN   WCHAR* FilterMask,
     IN   WCHAR* ReparseFilterMask
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

ReparseFilterMask

The reparse folder mask, it can include the wild character, but it must match the wild character in FilterMask.

For example:
FilterMask = c:\test*txt
ReparseFilterMask = d:\reparse*doc

If you open file c:\test\MyTest.txt, it will reparse to the file d:\reparse\MyTest.doc.

Return Value

Return true if it succeeds, else return false.

Comments

If the REPARSE_FILE_OPEN was enabled in the access flag in the API AddNewFilterRule, this is the API to add the reparse filter mask for the filter rule.

BOOL

AddHiddenFileMaskToFilterRule(

```
     IN   WCHAR* FilterMask,
     IN   WCHAR* HiddenFileFilterMask
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

HiddenFileFilterMask

The hidden file filter mask for the files to be hidden.

For example:
FilterMask = c:\hideFilesTest*
HiddenFileFilterMask = *.doc

If you open folder c:\hideFilesTest, all the files with extension .doc won't show up in the folder.

Return Value

Return true if it succeeds, else return false.

Comments

If the HIDE_FILES_IN_DIRECTORY_BROWSING was enabled in the access flag in the API AddNewFilterRule, this is the API to add the hidden filter mask for the filter rule.

BOOL

AddExcludeFileMaskToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* ExcludeFileFilterMask
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

ExcludeFileFilterMask

The file filter mask to be excluded.

For example:
FilterMask = *.txt
ExcludeFileFilterMask = c:\windows*

The filter driver target file is all the files with extension .txt except the files in folder c:\windows and its subfolders.

Return Value

Return true if it succeeds, else return false.

Comments

This is the API to add the exclude file filter mask for the filter rule which was set in AddNewFilterRule.

BOOL

AddIncludeProcessIdToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG IncludeProcessId
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

IncludeProcessId
The process Id to be included by filter driver.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the include process Id for the filter rule which was set in AddNewFilterRule,only the files opened by the processes in the included process Ids and process names will be monitored by the filter driver.

BOOL

AddExcludeProcessIdToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   ULONG ExcludeProcessId
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

ExcludeProcessId
The process Id to be excluded by filter driver.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the exclude process Id for the filter rule which was set in AddNewFilterRule, all the files were opened by the processes in the excluded process Ids and process names won't be monitored by the filter driver.

BOOL

AddIncludeProcessNameToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* IncludeProcessName
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

IncludeProcessName
The process name to be included by filter driver.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the include process name for the filter rule which was set in AddNewFilterRule, only the files opened by the processes in the included process Ids and process names will be monitored by the filter driver.

BOOL

AddExcludeProcessNameToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* ExcludeProcessName
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

ExcludeProcessName
The process name to be excluded by filter driver.

Return Value

Return true if it succeeds, else return false.

Comments

This is the API to add the exclude process name for the filter rule which was set in AddNewFilterRule, all the files were opened by the processes in the excluded process Ids and process names won't be monitored by the filter driver.

BOOL

AddIncludeUserNameToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* IncludeUserName
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

IncludeUserName

The user name to be included by filter driver.

Return Value

Return true if it succeeds, else return false.

Comments

This is the API to add the include user name for the filter rule which was set in AddNewFilterRule,only the files were opened by the useres in the included user names will be monitored by the filter driver.

BOOL

AddExcludeProcessNameToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* ExcludeUserName
)
```

Parameters

FilterMask

The FilterMask which was set in API AddNewFilterRule.

ExcludeUserName
The process name to be excluded by filter driver.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the exclude process name for the filter rule which was set in AddNewFilterRule, all the files were opened by the users in the excluded user names won't be monitored by the filter driver.

BOOL

AddProcessRightsToFilterRule(

```
IN   WCHAR* FilterMask,
IN   WCHAR* ProcessName,
IN   ULONG  AccessFlag
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

ProcessName
The process name to be set access rights.

AccessFlag
The access rights for the process.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the access flags to the specific process,when the process accesses the files, it needs to check permission from access flags firt to allow or deny the file access.

BOOL

AddUserRightsToFilterRule(

```
IN   WCHAR* FilterMask,
```

```
    IN   WCHAR* UserName,
    IN   ULONG  AccessFlag
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

UserName
The user name to be set access rights.

AccessFlag
The access rights for the user.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the access flags to the specific user,when the user accesses the files, it needs to check permission from access flags firt to allow or deny the file access.

BOOL

AddIncludeUserNameToFilterRule(

```
    IN   WCHAR* FilterMask,
    IN   WCHAR* IncludeUserName
)
```

Parameters

FilterMask
The FilterMask which was set in API AddNewFilterRule.

IncludeUserName
The user name to be included by filter driver.

Return Value
Return true if it succeeds, else return false.

Comments

This is the API to add the include user name for the filter rule which was set in AddNewFilterRule,only the files were opened by the useres in the included user names will be monitored by the filter driver.

BOOL

RemoveFilterRule(WCHAR FilterMask);*

Parameters

FilterMask
The FilterMask associated to the filter rule.

Return Value
Return true if it succeeds, else return false.

Comments

You can remove the filter rule which was set by AddFilterRule API.

BOOL

AddIncludedProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to be included by filter.

Return Value
Return true if it succeeds, else return false.

Comments

This API let the filter dirver only intercept the I/O for the included processes,discard all other I/O from other processes, you can add multiple process Id.

BOOL

RemoveExcludeProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to remove which set by AddIncludedProcessId API.

Return Value
Return true if it succeeds, else return false.

Comments

This API removes the included process Id from filter.

BOOL

AddExcludedProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to be excluded by filter.

Return Value
Return true if it succeeds, else return false.

Comments

This API let you can bypass the filter for specific processes, you can add multiple process Id.

BOOL

RemoveExcludeProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to remove which set by AddExcludedProcessId API.

Return Value
Return true if it succeeds, else return false.

Comments

This API removes the excluded process Id from filter.

BOOL

AddProtectedProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to be protected by filter.

Return Value
Return true if it succeeds, else return false.

Comments

This API can prevent the process being terminated, you can add multiple process Id, this API is supported in OS vista or later versions.

BOOL

RemoveProtectedProcessId(ULONG ProcessId)

Parameters

ProcessId
The process Id you want to remove which set by *AddProtectedProcessId* API.

Return Value
Return true if it succeeds, else return false.

Comments

This API removes the protected procss Id.

BOOL

RegisterIoRequest(ULONG RequestRegistration)

Parameters

RequestRegistration
The RequestRegistration is the bit combination of the request type.

Return Value

Return true if it succeeds, else return false.

Comments

Register the I/O requests which you want to monitor. For File_SYSTEM_MONITOR filter, only post I/O requests registration are affected, since it only can get notification after the request was completed by file system.

For FILE_SYSTEM_CONTROL filter you can register both pre and post reqeusts. If you want to deny, cancel or return with your own data instead of going down to the file system, you need to register the pre request.

For some post I/O requests, you can't cancel or deny it, for example Create, Set information,Set security, Write requests.

BOOL

GetFileHandleInFilter(WCHAR FileName, ULONG DesiredAccess, Handle* FileHandle);*

Parameters

FileName

The full path of the file which you want to open.

DesiredAccess

The requested access to the file or device, which can be summarized as read, write, both or neither zero).

FileHandle

The pointer to the file handle which will receive the file handle after the file was opened.

Return Value

Return true if it succeeds, else return false.

Comments

Use this API to open the file,it will bypass the filter, avoid reentrant issue.It also will bypass the security check.Close the handle with CloseHandle win32 API.

BOOL

AESEncryptFile(

```
IN   WCHAR* FileName,
IN   ULONG  KeyLength,
IN   UCHAR* Key,
IN   ULONG  IVLength,
IN   UCHAR* IV,
IN   BOOL   AddIVTag )
```

Parameters

FileName

The file name to be encrypted.

KeyLength

The encryption key length,it has to be 16(128bits),24(192bits) or 32(256bits).

Key

The encryption key,it is an unsigned char array with KeyLength size.

IVLength

The initial vector length,if it is 0, the sysem will allocate an unique IV for the file.

IV

The initial vector,when IVLenght is 0, it sets to NULL.

AddIVTag

If it is true,it will add the IV to the encrypted file as reparse point tag,then the encryption filter driver can recognize this encrypted file.

Return Value

Return true if it succeeds, else return false.

Comments

AESEncryptFile is the API to encrypt file file with AES encryption cryptographic algorithm.

BOOL

AESEncryptFileToFile(

```
IN   WCHAR* SourceFileName,
IN   WCHAR* DestFileName,
IN   ULONG  KeyLength,
IN   UCHAR* Key,
IN   ULONG  IVLength,
IN   UCHAR* IV,
IN   BOOL   AddIVTag )
```

Parameters

SourceFileName

The source file name to be encrypted.

DestFileName

The target file name was encrypted.

KeyLength

The encryption key length,it has to be 16(128bits),24(192bits) or 32(256bits).

Key

The encryption key,it is an unsigned char array with KeyLength size.

IVLength

The initial vector length,if it is 0, the sysem will allocate an unique IV for the file.

IV

The initial vector,when IVLenght is 0, it sets to NULL.

AddIVTag

If it is true,it will add the IV to the encrypted file as reparse point tag,then the encryption filter driver can recognize this encrypted file.

Return Value

Return true if it succeeds, else return false.

Comments

AESEncryptFileToFile is the API to encrypt file file with AES encryption cryptographic algorithm.

BOOL

AESDecryptFile(

```
IN   WCHAR* FileName,
IN   ULONG  KeyLength,
IN   UCHAR* Key,
IN   ULONG  IVLength,
IN   UCHAR* IV )
```

Parameters

FileName

The file name to be decrypted.

KeyLength

The encryption key length,it has to be 16(128bits),24(192bits) or 32(256bits).

Key

The encryption key,it is an unsigned char array with KeyLength size.

IVLength

The initial vector length,if the encrypted file already has IVTag,it will use the IV tag instead of the pass in IV, if the encrypted file doesn't set the IV tag,then the IVLength can't be 0, and IV can't be NULL.

IV

The initial vector,when the encrypted file doesn't set IV tag, the IV can't be NULL, or it can be NULL.

Return Value

Return true if it succeeds, else return false.

Comments

AESDecryptFile is the API to decrypt file file with AES encryption cryptographic algorithm.

BOOL

AESDecryptFileToFile(

```
IN   WCHAR* SourceFileName,
IN   WCHAR* DestFileName,
IN   ULONG  KeyLength,
```

```
IN   UCHAR* Key,
IN   ULONG  IVLength,
IN   UCHAR* IV )
```

Parameters

SourceFileName

The encrypted file name.

DestFileName

The target file name was decrypted.

KeyLength

The encryption key length,it has to be 16(128bits),24(192bits) or 32(256bits).

Key

The encryption key,it is an unsigned char array with KeyLength size.

IVLength

The initial vector length,if the encrypted file already has IVTag,it will use the IV tag instead of the pass in IV, if the encrypted file doesn't set the IV tag,then the IVLength can't be 0, and IV can't be NULL.

IV

The initial vector,when the encrypted file doesn't set IV tag, the IV can't be NULL, or it can be NULL.

Return Value

Return true if it succeeds, else return false.

Comments

AESDecryptFileToFile is the API to decrypt file file with AES encryption cryptographic algorithm.

BOOL

AddIVTag(

```
IN   WCHAR* FileName,
IN   ULONG  IVLength,
IN   UCHAR* IV )
```

Parameters

FileName
The file name was encrypted.

IVLength
The initial vector length.

IV
The initial vector.

Return Value
Return true if it succeeds, else return false.

Comments

AddIVTag is the API to add the IV tag to the encrypted file if it doesn't have the iv tag set, or it will return false.

BOOL

GetIVTag(

```
IN          WCHAR* FileName,
IN Out      ULONG* IVLength,
IN out      UCHAR* IV )
```

Parameters

FileName
The file name was encrypted.

IVLength
The pointer to the initial vector length,the iv length always is 16,it has to be 16,it will return 0 if the file is not encrypted.

IV
The pointer to the buffer to receive the initial vector.

Return Value
Return true if it succeeds, else return false.

Comments

GetIVTag is the API to get the IV tag from the encrypted file if it has the iv tag set, or IVLength will return 0.

BOOL

DeleteIVTag(

IN WCHAR FileName)*

Parameters

FileName

The file name was encrypted.

Return Value

Return true if it succeeds, else return false.

Comments

GetIVTag is the API to delete the IV tag from the encrypted file if it has the iv tag set, or it will return true.

How to use

The components

The EaseFilter file system filter SDK includes two components (EaseFlt.sys and FilterAPI.dll), The EaseFlt.sys and FilterAPI.dll are different for 32bit and 64bit windows system. EaseFlt.sys is the file system filter driver which implements all the functionalities in the file system level. FilterAPI.dll is a wrapper DLL which exports the API to the user mode applications.

To check the binary is 32 bit or 64 bit you can right click file and go to the property, then go to the "Details" tag and check the "file description" section.

Set up the filter

Install the filter driver with InstallDriver() method if the driver has not been installed yet. After filter driver was installed, the filter was loaded, if not you can load the filter with command "Fltmc load EaseFlt" in dos prompt. To remove the filter driver from the system, call UninstallDriver() method.

Start the filter

1. Activate the filter with API SetRegistrationKey(). You can request the trial license key with the link: http://www.easefilter.com/Order.htm or email us info@easefilter.com
2. After register the callback function with API RegisterMessageCallback, filter is started.

   BOOL ret = RegisterMessageCallback(FilterConnectionThreadsCount, MessageCallback, DisconnectCallback);

3. Setup the filter configuration after filter was started. First select the filter type, then add filter rule and register the I/O request:

   BOOL ret = SetFilterType(FILE_SYSTEM_MONITOR);
   BOOL ret = AddNewFilterRule(AccessFlags,L"C:\\MyMonitorFolder");*

   BOOL ret = RegisterIORequest(POST_CREATE|POST_CLEANUP);

We provide C++ example and C# example to demonstrate how to use the EaseFilter File System Monitor and Control Filter.

C++ Example

Copy the correct version (32bit or 64bit) EaseFlt.sys, FilterAPI.DLL,FilterAPI.h and FilterAPI.lib to your folder. FilterAPI.h file includes all the functions and structures used for connecting to the filter driver. WinDataStructures.h file is part of the structures of windows API which is used in the example, for more structures please reference Microsoft MSDN website.

For monitor filter, it will only display the file system call messages which include process Id, Thread Id, file name, user name, file system I/O type, etc.

For Control filter, the filter will block and wait for the response if that I/O was registered, so it is better handle this request as soon as possible, or it will block the system call.

C# Example

Copy the correct version (32bit or 64bit) EaseFlt.sys, FilterAPI.DLL and FilterAPI.cs to your folder. FilterAPI.cs has the structures and APIs used for connecting to the filter driver.