Microsoft

Azure RTOS FileX

User Guide

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Safety Certifications

IEC 61508 up to SIL 4
IEC 62304 up to SW safety Class C
ISO 26262 ASIL D
EN 50128 SW-SIL 4

UL/IEC 60730, UL/IEC 60335, UL 1998

MISRA-C:2004 Compliant
MISRA C:2012 Compliant

Part Number: 000-1001
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Contents

About This Guide

This guide contains comprehensive information about Azure RTOS FileX, the Microsoft high-performance real-time file system.

It is intended for the embedded real-time software developer. The developer should be familiar with standard real-time operating system functions, FAT file system services, and the C programming language.

Organization

Chapter 1	Introduces FileX.
Chapter 2	Gives the basic steps to install and use FileX with your ThreadX application.
Chapter 3	Provides a functional overview of the FileX system and basic information about FAT file system formats.
Chapter 4	Details the application's interface to FileX.
Chapter 5	Describes the supplied FileX RAM driver and how to write your own custom FileX drivers.
Chapter 6	Describes the FileX Fault Tolerant Module.

Appendix A	FileX Services
Appendix B	FileX Constants
Appendix C	FileX Data Types
Appendix D	ASCII Chart
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Guide Conventions

Italics	Typeface denotes book titles, emphasizes important words, and indicates variables.
Boldface	Typeface denotes file names, key words, and further emphasizes important words and variables.
i	Information symbols draw attention to important or additional information that could affect performance or function.
!	Warning symbols draw attention to situations that developers should avoid because they could cause fatal errors.

FileX Data Types

In addition to the custom FileX control structure data types, there is a series of special data types that are used in FileX service call interfaces. These special data types map directly to data types of the underlying C compiler. This is done to ensure portability between different C compilers. The exact implementation is inherited from ThreadX and can be found in the ***tx_port.h*** file included in the ThreadX distribution.

The following is a list of FileX service call data types and their associated meanings:

UINT	Basic unsigned integer. This type must support 8-bit unsigned data; however, it is mapped to the most convenient unsigned data type.
ULONG	Unsigned long type. This type must support 32-bit unsigned data.
VOID	Almost always equivalent to the compiler's void type.
CHAR	Most often a standard 8-bit character type.
ULONG64	64-bit unsigned integer data type.

Additional data types are used within the FileX source. They are located in either the ***tx_port.h*** or ***fx_port.h*** files.

Customer Support Center

Support email	azure-rtos-support@microsoft.com
Web page	http://azure.com/rtos

Latest Product Information

Visit the azure.com/rtos web site and select the "Support" menu to find the latest support information, including information about the latest FileX product releases.

What We Need From You

Provide us with the following information in an email message so we can more efficiently resolve your support request:

1. A detailed description of the problem, including frequency of occurrence and whether it can be reliably reproduced.
2. A detailed description of any changes to the application and/or FileX that preceded the problem.
3. The contents of the ***_tx_version_id*** and ***_fx_version_id*** strings found in the ***tx_port.h*** and ***fx_port.h*** files of your distribution. These strings will provide us valuable information regarding your run-time environment.
4. The contents in RAM of the following ULONG variables. These variables will give us information on how your ThreadX and FileX libraries were built:

   _tx_build_options

   _fx_system_build_options1
   _fx_system_build_options2
   _fx_system_build_options3

Where to Send Comments About This Guide

Email any comments and suggestions to the Customer Support Center at

azure-rtos-support@microsoft.com

Please enter “FileX User Guide” in the subject line.

Chapter 1: Introduction to FileX

Azure RTOS FileX is a complete FAT format media and file management system for deeply embedded applications. This chapter introduces FileX, describing its applications and benefits.

FileX Unique Features

FileX supports an unlimited number of media devices at the same time, including RAM disks, FLASH managers, and actual physical devices. It supports 12-, 16-, and 32-bit File Allocation Table (FAT) formats, and also supports Extended File Allocation Table (exFAT), contiguous file allocation, and is highly optimized for both size and performance. FileX also includes fault tolerant support, media open/close, and file write callback functions.

Designed to meet the growing need for FLASH devices, FileX uses the same design and coding methods as ThreadX. Like all Azure RTOS products, FileX is distributed with full ANSI C source code, and it has no run-time royalties.

Product Highlights

- Complete ThreadX processor support
- No royalties
- Complete ANSI C source code
- Real-time performance
- Responsive technical support
- Unlimited FileX objects (media, directories, and files)
- Dynamic FileX object creation/deletion
- Flexible memory usage
- Size scales automatically
- Small footprint (as low as 6 KBytes) instruction area size: 6-30K
- Complete integration with ThreadX
- Endian neutral
- Easy-to-implement FileX I/O drivers
- 12-, 16-, and 32-bit FAT support

- exFAT support
- Long filename support
- Internal FAT entry cache
- Unicode name support
- Contiguous file allocation
- Consecutive sector and cluster read/write
- Internal logical sector cache
- RAM disk demonstration runs out-of-the-box
- Media format capability
- Error detection and recovery
- Fault tolerant options
- Built-in performance statistics

Safety Certifications

TÜV Certification

FileX has been certified by SGS-TÜV Saar for use in safety-critical systems, according to IEC-61508 and IEC-62304. The certification confirms that FileX can be used in the development of safety-related software for the highest safety integrity levels of the International Electrotechnical Commission (IEC) 61508 and IEC 62304, for the “Functional Safety of electrical, electronic, and programmable electronic safety-related systems.” SGS-TÜV Saar, formed through a joint venture of Germany’s SGS-Group and TÜV Saarland, has become the leading accredited, independent company for testing, auditing, verifying, and certifying embedded software for safety-related systems worldwide. The industrial safety standard IEC 61508, and all standards that are derived from it, including IEC 62304, are used to assure the functional safety of electrical, electronic, and programmable electronic safety-related medical devices, process control systems, industrial machinery, and railway control systems.

SGS-TÜV Saar has certified FileX to be used in safety-critical automotive systems, according to the ISO 26262 standard. Furthermore, FileX is certified to Automotive Safety Integrity Level (ASIL) D, which represents the highest level of ISO 26262 certification.

In addition, SGS-TÜV Saar has certified FileX to be used in safety-critical railway applications, meeting to the EN 50128 standard up to SW-SIL 4.

IEC 61508 up to SIL 4
IEC 62304 up to SW safety Class C
ISO 26262 ASIL D
EN 50128 SW-SIL 4

Please contact azure-rtos-support@microsoft.com for more information on which version(s) of FileX have been certified by TÜV or for the availability of test reports, certificates, and associated documentation.

UL Certification

FileX has been certified by UL for compliance with UL 60730-1 Annex H, CSA E60730-1 Annex H, IEC 60730-1 Annex H, UL 60335-1 Annex R, IEC 60335-1 Annex R, and UL 1998 safety standards for software in programmable components. Along with IEC/UL 60730-1, which has requirements for “Controls Using Software” in its Annex H, the IEC 60335-1 standard describes the requirements for “Programmable Electronic Circuits” in its Annex R. IEC 60730 Annex H and IEC 60335-1 Annex R address the safety of MCU hardware and software used in appliances such as washing machines, dishwashers, dryers, refrigerators, freezers, and ovens.

UL/IEC 60730, UL/IEC 60335, UL 1998

Please contact azure-rtos-support@microsoft.com for more information on which version(s) of FileX have been certified by UL or for the availability of test reports, certificates, and associated documentation.

Powerful Services of FileX

Multiple Media Management

FileX can support an unlimited number of physical media. Each media instance has its own distinct memory area and associated driver specified on the ***fx_media_open*** API call. The default distribution of FileX comes with a simple RAM media driver and a demonstration system that uses this RAM disk.

Logical Sector Cache

By reducing the number of whole sector transfers, both to and from the media, the FileX logical sector cache significantly improves performance. FileX maintains a logical sector cache for each opened media. The depth of the logical sector cache is determined by the amount of memory supplied to FileX with the ***fx_media_open*** API call.

Contiguous File Support

FileX offers contiguous file support through the API service ***fx_file_allocate*** to improve and make file access time deterministic. This routine takes the amount of memory requested and looks for a series of adjacent clusters to satisfy the request. If such clusters are found, they are pre-allocated by making them part of the file's chain of allocated clusters. On moving physical media, the FileX contiguous file support results in a significant performance improvement and makes the access time deterministic.

Dynamic Creation

FileX allows you to create system resources dynamically. This is especially important if your application has multiple or dynamic configuration requirements. In addition, there are no predetermined limits on the number of FileX resources you can use (media or files). Also, the number of system objects does not have any impact on performance.

Easy-to-use API

FileX provides the very best deeply embedded file system technology in a manner that is easy to understand and easy to use! The FileX Application Programming Interface (API) makes the services intuitive and consistent. You won't have to decipher “alphabet soup” services that are all too common with other file systems.

For a complete list of the FileX Version 5 Services, see Appendix A on page 265.

exFAT Support

exFAT (extended File Allocation Table) is a file system designed by Microsoft to allow file size to exceed 2GB, a limit imposed by FAT32 file systems.

It is the default file system for SD cards with capacity over 32GB. SD cards or flash drives formatted with FileX exFAT format are compatible with Windows. exFAT supports file size up to one Exabyte (EB), which is approximately one billion GB.

Users wishing to use exFAT must recompile the FileX library with the symbol ***FX_ENABLE_EXFAT*** defined. When opening media, FileX detects the media type. If the media is formatted with exFAT, FileX reads and writes the file system following exFAT standard. To format new media with exFAT, use the service ***fx_media_exFAT_format***. By default exFAT is not enabled.

Fault Tolerant Support

The FileX Fault Tolerant Module is designed to prevent file system corruption caused by interruptions during the file or directory update. For example, when appending data to a file, FileX needs to update the content of the file, the directory entry, and possibly the FAT entries. If this sequence of update is interrupted (such as power glitch, or the media is ejected in the middle of the update), the file system is in an inconsistent state, which may affect the integrity of the entire file system, leading towards corruption of other files.

The FileX Fault Tolerant Module works by recording all steps required to update a file or a directory along the way. This log entry is stored on the media in dedicated sectors (blocks) that FileX can find and access. The location of the log data can be accessed without proper file system. Therefore, in case the file system is corrupted, FileX is still able to find the log entry and restore the file system back into a good state.

As FileX updates file or directory, log entries are created. After the update operation is successfully completed, the log entries are removed. If the log entries were not properly removed after a successful file update, if the recovery process determines that the content in the log entry matches the file system, nothing needs to be done, and the log entries can be cleaned up.

In case the file system update operation was interrupted, next time the media is mounted by FileX, the Fault Tolerant Module analyzes the log entries. The information in the log entries allows FileX to back out partial changes already applied to the file system (in case the failure happens during the early stage of the file update operation), or if the log entries contain re-do information, FileX is able to apply the changes required to finish the prior operation.

This fault tolerant feature is available to all FAT file systems supported by FileX, including FAT12, FAT16, FAT32, and exFAT. By default fault tolerant is not enabled in FileX. To enable the fault tolerant feature, FileX must be built with the symbol ***FX_ENABLE_FAULT_TOLERANT*** and ***FX_FAULT_TOLERANT*** defined. At run time, the application starts fault tolerant service by calling ***fx_fault_tolerant_enable()***. After the service starts, all file and directory write operations go through the Fault Tolerant Module.

As fault tolerant service starts, it first detects whether or not the media is protected under the Fault Tolerant Module. If it is not, FileX assumes integrity of the file system, and starts protection by allocating free blocks from the file system to be used for logging and caching. If the Fault Tolerant Module logs are found on the file system, it analyzes the log entries. FileX reverts the prior operation or redoes the prior operation, depending on the content of the log entries. The file system becomes available after all the prior log entries are processed. This ensures that FIleX starts from a known good state.

After a media is protected under the FileX Fault Tolerant Module, the media will not be updated with another file system. Doing so would leave the log entries on the file system inconsistent with the contents in the FAT table, the directory entry. If the media is updated by another file system before moving it back to FileX with the Fault Tolerant Module, the result is undefined.

Callback Functions

The following three callback functions are added to FileX:

- Media Open callback
- Media Close callback
- File Write callback

After registered, these functions will notify the application when such events occur.

Easy Integration

FileX is easily integrated with virtually any FLASH or media device. Porting FileX is simple. This guide describes the process in detail, and the RAM driver of the demo system makes for a very good place to start!

Chapter 2: Installation and Use of FileX

This chapter contains an introduction to Azure RTOS FileX and a description of installation conditions, procedures, and use, including the following:

Host Considerations

Computer Type

Embedded development is usually performed on Windows or Linux (Unix) host computers. After the application is compiled, linked, and located on the host, it is downloaded to the target hardware for execution.

Download Interfaces

Usually the target download is done from within the development tool's debugger. After download, the debugger is responsible for providing target execution control (go, halt, breakpoint, etc.) as well as access to memory and processor registers.

Debugging Tools

Most development tool debuggers communicate with the target hardware via on-chip debug (OCD) connections such as JTAG (IEEE 1149.1) and Background Debug Mode (BDM). Debuggers also communicate with target hardware through In-Circuit Emulation (ICE) connections. Both OCD and ICE connections provide robust solutions with minimal intrusion on the target resident software.

Required Hard Disk Space

The source code for FileX is delivered in ASCII format and requires approximately 500 KBytes of space on the host computer’s hard disk.

*Please review the supplied **readme_filex.txt** file for additional host system considerations and options.*

Target Considerations

FileX requires between 6 KBytes and 30 KBytes of Read-Only Memory (ROM) on the target. Another 100 bytes of the target's Random Access Memory (RAM) are required for FileX global data structures. Each opened media also requires 1.5 KBytes of RAM for the control block in addition to RAM for storing data for one sector (typically 512 bytes).

For date/time stamping to function properly, FileX relies on ThreadX timer facilities. This is implemented by creating a FileX-specific timer during FileX initialization. FileX also relies on ThreadX semaphores for multiple thread protection and I/O suspension.

Product Distribution

The exact content of the distribution CD depends on the target processor, development tools, and the FileX package. The following is a list of important files common to most product distributions:

FileX_Express_Startup.pdf
PDF that provides a simple, four-step procedure to get FileX running on a specific target processor/board and specific development tools.

readme_filex.txt
This file contains specific information about the FileX port, including information about the target processor and the development tools.

fx_api.h	This C header file contains all system equates, data structures, and service prototypes.
fx_port.h	This C header file contains all development-tool-specific data definitions and structures.
demo_filex.c	This C file contains a small demo application.
fx.a (or fx.lib)	This is the binary version of the FileX C library. It is distributed with the standard package.

All file names are in lower-case. This naming convention makes it easier to convert the commands to Linux (Unix) development platforms.

FileX Installation

Installation of FileX is straightforward. Refer to the ***FileX_Startup.pdf*** file and the ***readme_filex.txt*** file for specific information on installing FileX for your environment

.Be sure to back up the FileX distribution disk and store it in a safe location.

Application software needs access to the FileX library file (usually called usually ***fx.a*** or ***fx.lib***) *and the C include files* **fx_api.h** *and* **fx_port.h**. *This is accomplished either by setting the appropriate path for the development tools or by copying these files into the application development area.*

Using FileX

Using FileX is easy. Basically, the application code must include ***fx_api.h*** during compilation and link with the FileX run-time library ***fx.a*** (or ***fx.lib***). Of course, the ThreadX files, namely ***tx_api.h*** and ***tx.a*** (or ***tx.lib***), are also required.

Assuming you are already using ThreadX, there are four steps required to build a FileX application:

Step 1: Include the ***fx_api.h*** file in all application files that use FileX services or data structures.

Step 2: Initialize the FileX system by calling ***fx_system_initialize*** from the ***tx_application_define*** function or an application thread.

Step 3: Add one or more calls to ***fx_media_open*** to set up the FileX media. This call must be made from the context of an application thread.

*Remember that the **fx_media_open** call requires enough RAM to store data for one sector.*

Step 4: Compile application source and link with the FileX and ThreadX run-time libraries, ***fx.a*** (or ***fx.lib***) and ***tx.a*** (or ***tx.lib***). The resulting image can be downloaded to the target and executed!

Troubleshooting

Each FileX port is delivered with a demonstration application. It is always a good idea to get the demonstration system running first—either on the target hardware or a specific demonstration environment.

*See the **readme_filex.txt** file supplied with the distribution disk for details regarding the demonstration system.*

If the demonstration system does not work, try the following things to narrow the problem:

1. Determine how much of the demonstration is running.
2. Increase stack sizes (this is more important in actual application code than it is for the demonstration).
3. Ensure there is enough RAM for the 32KBytes default RAM disk size. The basic system will operate on much less RAM; however, as more of the RAM disk is used, problems will surface if there is not enough memory.
4. Temporarily bypass any recent changes to see if the problem disappears or changes. Such information should prove useful to support engineers. Follow the procedures outlined in “Customer Support Center” on page 12 to send the information gathered from the troubleshooting steps.

Configuration Options

There are several configuration options when building the FileX library and the application using FileX. The options below can be defined in the application source, on the command line, or within the ***fx_user.h*** include file.

*Options defined in **fx_user.h** are applied only if the application and ThreadX library are built with **FX_INCLUDE_USER_DEFINE_FILE** defined.*

Review the ***readme_filex.txt*** file for additional options for your specific version of FileX. The following list describes each configuration option in detail:

Define	Meaning
FX_MAX_LAST_NAME_LEN	This value defines the maximum file name length, which includes full path name. By default, this value is 256.
FX_DONT_UPDATE_OPEN_FILES	Defined, FileX does not update already opened files.
FX_MEDIA_DISABLE_SEARCH_CACHE	Defined, the file search cache optimization is disabled.
FX_DISABLE_DIRECT_DATA_READ_CACHE_FILL	Defined, the direct read sector update of cache is disabled.
FX_MEDIA_STATISTICS_DISABLE	Defined, gathering of media statistics is disabled.
FX_SINGLE_OPEN_LEGACY	Defined, legacy single open logic for the same file is enabled.
FX_RENAME_PATH_INHERIT	Defined, renaming inherits path information.
FX_DISABLE_ERROR_CHECKING	Removes the basic FileX error checking API and results in improved performance (as much as 30%) and smaller code size.

Define	Meaning
FX_MAX_LONG_NAME_LEN	Specifies the maximum file name size for FileX. The default value is 256, but this can be overridden with a command-line define. Legal values range between 13 and 256.
FX_MAX_SECTOR_CACHE	Specifies the maximum number of logical sectors that can be cached by FileX. The actual number of sectors that can be cached is lesser of this constant and how many sectors can fit in the amount of memory supplied at ***fx_media_open***. The default value is 256. All values must be a power of 2.
FX_FAT_MAP_SIZE	Specifies the number of sectors that can be represented in the FAT update map. The default value is 256, but this can be overridden with a command-line define. Larger values help reduce unneeded updates of secondary FAT sectors.
FX_MAX_FAT_CACHE	Specifies the number of entries in the internal FAT cache. The default value is 16, but this can be overridden with a command-line define. All values must be a power of 2.
FX_FAULT_TOLERANT	When defined, FileX immediately passes write requests of all system sectors (boot, FAT, and directory sectors) to the media's driver. This potentially decreases performance, but helps limit corruption to lost clusters. Note that enabling this feature does not automatically enable FileX Fault Tolerant Module, which is enabled by defining ***FX_ENABLE_FAULT_TOLERANT***.

Define	Meaning
FX_FAULT_TOLERANT_DATA	When defined, FileX immediately passes all file data write requests to the media's driver. This potentially decreases performance, but helps limit lost file data. Note that enabling this feature does not automatically enable FileX Fault Tolerant Module, which is enabled by defining ***FX_ENABLE_FAULT_TOLERANT***.
FX_NO_LOCAL_PATH	Removes local path logic from FileX, resulting in smaller code size.
FX_NO_TIMER	Eliminates the ThreadX timer setup to update the FileX system time and date. Doing so causes default time and date to be placed on all file operations.
FX_UPDATE_RATE_IN_SECONDS	Specifies rate at which system time in FileX is adjusted. By default, value is 10, specifying that the FileX system time is updated every 10 seconds.
FX_ENABLE_EXFAT	When defined, the logic for handling exFAT file system is enabled in FileX. By default this symbol is not defined.
FX_UPDATE_RATE_IN_TICKS	Specifies the same rate as ***FX_UPDATE_RATE_IN_SECONDS*** (see above), except in terms of the underlying ThreadX timer frequency. The default is 1000, which assumes a 10ms ThreadX timer rate and a 10 second interval.
FX_SINGLE_THREAD	Eliminates ThreadX protection logic from the FileX source. It should be used if FileX is being used only from one thread or if FileX is being used without ThreadX.
FX_DRIVER_USE_64BIT_LBA	When defined, enables 64-bit sector addresses used in I/O driver. By default this option is not defined.

Define	Meaning
FX_ENABLE_FAULT_TOLERANT	When defined, enables FileX Fault Tolerant Module. Enabling Fault Tolerant automatically defines the symbol ***FX_FAULT_TOLERANT*** and ***FX_FAULT_TOLERANT_DATA***. By default this option is not defined.
FX_FAULT_TOLERANT_BOOT_INDEX	Defines byte offset in the boot sector where the cluster for the fault tolerant log is. By default this value is 116. This field takes 4 bytes. Bytes 116 through 119 are chosen because they are marked as reserved by FAT 12/16/32/exFAT specification.
FX_FAULT_TOLERANT_MINIMAL_CLUSTER	This symbol is deprecated. It is no longer being used by FileX Fault Tolerant.

FileX Version ID

The current version of FileX is available both to the user and the application software during run-time. The programmer can obtain the FileX version from examination of the ***readme_filex.txt*** file. In addition, this file also contains a version history of the corresponding port. Application software can obtain the FileX version by examining the global string ***_fx_version_id***.

Chapter 3: Functional Components of FileX

This chapter contains a description of the high-performance Azure RTOS FileX embedded file system from a functional perspective. This includes the following:

Media Description

FileX is a high-performance embedded file system that conforms to the FAT file system format. FileX views the physical media as an array of logical sectors. How these sectors are mapped to the underlying physical media is determined by the I/O driver connected to the FileX media during the ***fx_media_open*** call.

FAT12/16/32 Logical Sectors

The exact organization of the media's logical sectors is determined by the contents of the physical media's boot record. The general layout of the media's logical sectors is shown in Figure 1 on page 35.

FileX logical sectors start at logical sector 1, which points to the first reserved sector of the media. Reserved sectors are optional, but when in use they typically contain system information such as boot code.

FAT12/16/32 Media Boot Record

The exact sector offset of the other areas in the logical sector view of the media is derived from the contents of the *media boot record*. The location of the boot record is typically at sector 0. However, if the media has *hidden sectors*, the offset to the boot sector must account for them (they are located immediately BEFORE the boot sector). Table 1 on page 36 lists the media's boot record components, and the components are described in the paragraphs.

Jump Instruction: The *jump instruction* field is a three-byte field that represents an Intel x86 machine instruction for a processor jump. This is a legacy field in most situations.

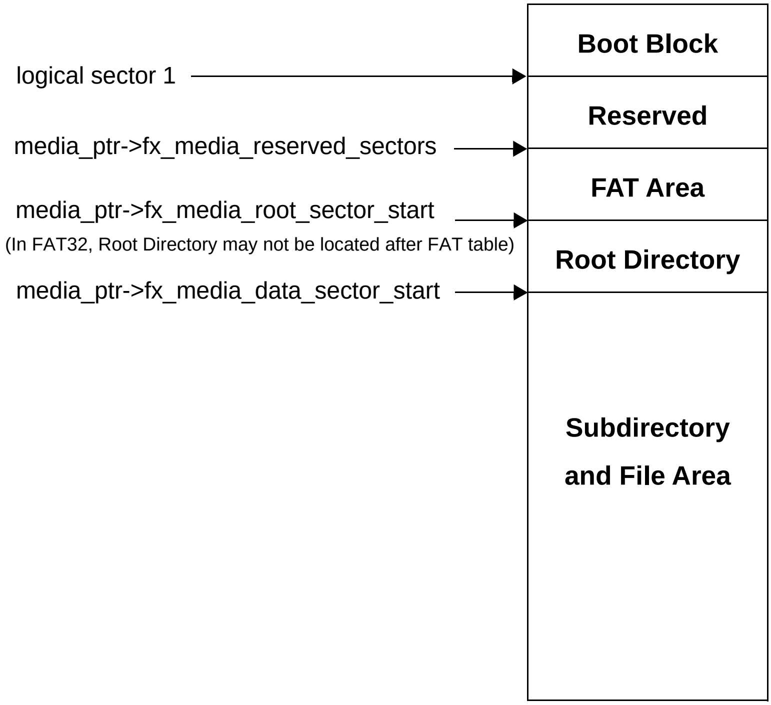

FIGURE 1. FileX Media Logical Sector View

OEM Name: The *OEM name* field is reserved for manufacturers to place their name or a name for the device.

Bytes Per Sector: The *bytes per sector* field in the media boot record defines how many bytes are in each sector—the fundamental element of the media.

Sectors Per Cluster: The ***sectors per cluster*** field in the media boot record defines the number of sectors assigned to a cluster. The cluster is the fundamental allocation element in an FAT compatible file system. All file information and subdirectories are

TABLE 1. FileX Media Boot Record

Offset	Field	Number of Bytes
0x00	Jump Instruction (e9,xx,xx or eb,xx,90)	3
0x03	OEM Name	8
0x0B	Bytes Per Sector	2
0x0D	Sectors Per Cluster	1
0x0E	Number of Reserved Sectors	2
0x10	Number of FATs	1
0x11	Size of Root Directory	2
0x13	Number of Sectors FAT-12 & FAT-16	2
0x15	Media Type	1
0x16	Number of Sectors Per FAT	2
0x18	Sectors Per Track	2
0x1A	Number of Heads	2
0x1C	Number of Hidden Sectors	4
0x20	Number of Sectors - FAT-32	4
0x24	Sectors per FAT (FAT-32)	4
0x2C	Root Directory Cluster	4
0x3E	System Boot code	448
0x1FE	0x55AA	2

allocated from the media's available clusters as determined by the File Allocation Table (FAT).

Reserved Sectors: The *reserved sectors* field in the media boot record defines the number of sectors reserved between the boot record and the first sector of the FAT area. This entry is zero in most cases.

Number of FATs: The *number of FATs* entry in the media boot record defines the number of FATs in the media. There must always be at least one FAT in a media. Additional FATs are merely duplicate copies of the primary (first) FAT and are typically used by diagnostic or recovery software.

Root Directory Size: The *root directory size* entry in the media boot record defines the fixed number of entries in the root directory of the media. This field is not applicable to subdirectories and the FAT-32 root directory because they are both allocated from the media's clusters.

Number of Sectors FAT-12 & FAT-16: The *number of sectors* field in the media boot record contains the total number of sectors in the media. If this field is zero, then the total number of sectors is contained in the *number of sectors FAT-32* field located later in the boot record.

Media Type: The *media type* field is used to identify the type of media present to the device driver. This is a legacy field.

Sectors Per FAT: The *sectors per FAT* filed in the media boot record contains the number of sectors associated with each FAT in the FAT area. The number of FAT sectors must be large enough to account for the maximum possible number of clusters that can be allocated in the media.

Sectors Per Track: The *sectors per track* field in the media boot record defines the number of sectors per track. This is typically only pertinent to actual disk-type media. FLASH devices don't use this mapping.

Number of Heads: The *number of heads* field in the media boot record defines the number of heads in the media. This is typically only pertinent to actual disk-type media. FLASH devices don't use this mapping.

Hidden Sectors: The *hidden sectors* field in the media boot record defines the number of sectors before the boot record. This field is maintained in the ***FX_MEDIA*** control block and must be accounted for in FileX I/O drivers in all read and write requests made by FileX.

Number of Sectors FAT-32: The *number of sectors* field in the media boot record is valid only if the two-byte *number of sectors* field is zero. In such a case, this four-byte field contains the number of sectors in the media.nn

Sectors per FAT (FAT-32): The *sectors per FAT (FAT-32)* field is valid only in FAT-32 format and contains the number of sectors allocated for each FAT of the media.

Root Directory Cluster: The *root directory cluster* field is valid only in FAT-32 format and contains the starting cluster number of the root directory.

System Boot Code: The *system boot code* field is an area to store a small portion of boot code. In most devices today, this is a legacy field.

Signature 0x55AA: The *signature* field is a data pattern used to identify the boot record. If this field is not present, the boot record is not valid.

exFAT

The maximum file size in FAT32 is 4GB, which limits the wide adoption of high-definition multimedia files. By default FAT32 supports storage media up to

32GB. With increasing flash and SD card capacity, FAT32 becomes less efficient in managing large volumes. exFAT is designed to overcome these limitations. exFAT supports file size up to one Exabyte (EB), which is approximately one billion GB. Another significant difference between exFAT and FAT32 is that exFAT uses bitmap to manage available space in the volume, making exFAT more efficient in finding available space when writing data to the file. For file stored in contiguous clusters, exFAT eliminates the walking down the FAT chain to find all the clusters, making it more efficient when accessing large files. exFAT is required for flash storage and SD cards larger than 32GB.

exFAT Logical Sectors

The general layout of the media's logical sectors in exFAT is illustrated in Figure 2 on page 40. In exFAT the boot block and the FAT area belong to System Area. The rest of the clusters are User Area. Although not required, exFAT standard does recommend that the Allocation Bitmap is at the beginning of the User Area, followed by the Up-case Table and the root directory.

exFAT Media Boot Record

The content of the Media Boot Record in exFAT is different from those in FAT12/16/32. They are listed in Table 2 on page 41. To prevent confusion, the area between 0x0B and 0x40, which contains various media parameters in FAT12/16/32 is marked as *Reserved* in exFAT. This reserved area must be programmed with zeros, avoiding any misinterpreting the Media Boot Record.

Jump Instruction: The *jump instruction* field is a three-byte field that represents an Intel x86 machine instruction for a processor jump. This is a legacy field in most situations.

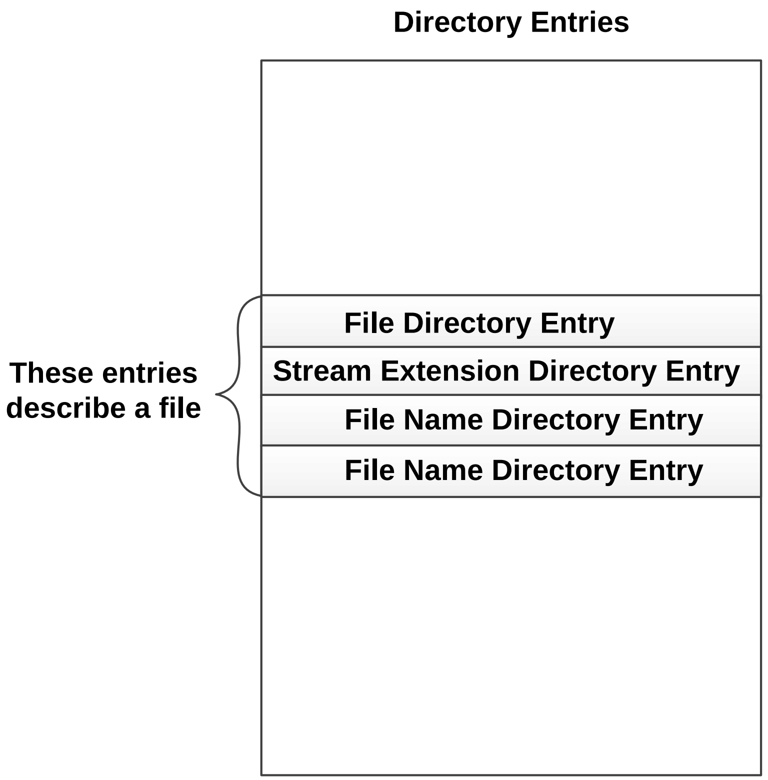

FIGURE 2. exFAT Logical Sectors

File System Name: For exFAT the *file system name* field must be “EXFAT” followed by three trailing white spaces.

Reserved: The content of the reserved field must be zero. This region overlaps with the boot records in FAT12/16/32. Making this area zero avoids file systems from mis-interprets this volume.

Partition Offset : The *partition offset* field indicates the starting of this partition.

TABLE 2. exFAT Media Boot Record

Offset	Field	Number of Bytes
0x00	Jump Instruction	3
0x03	File System Name	8
0x0B	Reserved	53
0x40	Partition Offset	8
0x48	Volume Length	8
0x50	FAT Offset	4
0x54	FAT Length	4
0x58	Cluster Heap Offset	4
0x5C	Cluster Count	4
0x60	First Cluster of Root Directory	4
0x64	Volume Serial Number	4
0x68	File System Revision	2
0x6A	Volume Flags	2
0x6C	Bytes Per Sector Shift	1
0x6D	Sector Per Cluster Shift	1
0x6E	Number of FATs	1
0x6F	Drive Select	1
0x70	Percent in Use	7
0x71	Reserved	1
0x78	Boot Code	390
0x1FE	Boot Signature	2

Volume Length: The *volume length* field defines the size, in number of sectors, of this partition.

FAT Offset: The *FAT offset* field defines the starting sector number, relative to the beginning of this partition, of the FAT table for this partition.

FAT Length: The *FAT length* field defines the size of the FAT table, in number of sectors.

Cluster Heap Offset: The *cluster heap offset* field defines the starting sector number, relative to the beginning of the partition, of the cluster heap. Cluster heap is the area where the directories information and the file data are stored.

Cluster Count: The *cluster count* field defines the number of cluster this partition has.

First Cluster of Root Directory: The *first cluster of root direcotry* field defines the starting location of the root directory, which is recommend to be right after the allocation bitmap and the up-case table.

Volume Serial Number: The *volume serial number* field defines the serial number for this partition.

File System Revision: The *file system revision* field defines the major and minor version of exFAT.

Volume Flags: The *volume flags* field contains flags indicating the state of this volume.

Bytes Per Sector Shift: The *bytes per sector shift* field defines the number of bytes per sector, in log2(n), where n is the number of bytes per sector. For example, in SD card, sector size is 512 bytes. Therefore this field shall be 9 (log2(512) = 9).

Sectors Per Cluster Shift: The *sectors per cluster shift* field defines the number of sectors in a cluster, in log2(n) where n is the number of sectors per cluster.

Number of FATs: The *number of FATs* field defines the number of FAT tables in this partition. For exFAT, the value is recommended to be 1, for one FAT table.

Drive Select: The *driver select* field defines the extended INT 13h drive number.

Percent in Use: The *percent in use* field define the percentage of the clusters in the cluster heap is being allocated. The valid values are between 0 and 100, inclusive.

Reserved: This field is reserved for future use.

Boot Code: The *boot code* field is an area to store a small portion of the boot code. In most devices today, this is a legacy field.

Signature 0x55AA: The *boot signature* field is a data pattern used to identify the boot record. If this field is not present, the boot record is not valid.

File Allocation Table (FAT)

The *File Allocation Table (FAT)* starts after the reserved sectors in the media. The FAT area is basically an array of 12-bit, 16-bit, or 32-bit entries that determine if that cluster is allocated or part of a chain of clusters comprising a subdirectory or a file. The size of each FAT entry is determined by the number of clusters that need to be represented. If the number of clusters (derived from the total sectors divided by the sectors per cluster) is less than or equal to 4,086, 12-bit FAT entries are used. If the total number of clusters is greater than 4,086 and less than 65,525, 16-bit FAT entries are used. Otherwise, if the total number of clusters is greater than or equal to 65,525, 32-bit FAT or exFAT are used.

For FAT12/16/32, the FAT table not only maintains the cluster chain, it also provides information on cluster allocation: whether or not a cluster is available. In exFAT, the cluster allocation information is maintained by an Allocation Bitmap Directory Entry. Each partition has its own allocation bitmap. The size of the bitmap is large enough to cover all the available clusters. If a cluster is available for allocation, the corresponding bit in the allocation bitmap is set to 0. Otherwise the bit is set to 1. For a file that occupies consecutive clusters, exFAT does not require a FAT chain to keep track of all the clusters. However, for a file that does not occupy consecutive clusters, a FAT chain still needs to be maintained.

FAT Entry Contents: The first two entries in the FAT table are not used and typically have the following contents:

FAT Entry	12-bit FAT	16-bit FAT	32-bit FAT	exFAT
Entry 0:	0x0F0	0x00F0	0x000000F0	0xF8FFFFFF
Entry 1:	0xFFF	0xFFFF	0x0FFFFFFF	0xFFFFFFFF

FAT entry number 2 represents the first cluster in the media's data area. The contents of each cluster entry determines whether or not it is free or part of a linked list of clusters allocated for a file or a subdirectory. If the cluster entry contains another valid cluster entry, then the cluster is allocated and its value points to the next cluster allocated in the cluster chain.

Possible cluster entries are defined as follows:

Meaning	12-bit FAT	16-bit FAT	32-bit FAT	exFAT
Free Cluster	0x000	0x0000	0x00000000	0x00000000
Not Used	0x001	0x0001	0x00000001	0x00000001
Reserved	0xFF0-FF6	0xFFF0-FFF6	0x0FFFFFF0-6	ClusterCounter + 2 to 0xFFFFFFF6
Bad Cluster	0xFF7	0xFFF7	0x0FFFFFF7	0xFFFFFFF7
Reserved	-	-	-	0xFFFFFFF8-E
Last Cluster	0xFF8-FFF	0xFFF8-FFFF	0x0FFFFFF8-F	0xFFFFFFFF
Cluster Link	0x002-0xFEF	0x0002-FFEF	0x2-0x0FFFFFEF	0x2 - ClusterCount + 1

The last cluster in an allocated chain of clusters contains the Last Cluster value (defined above). The first cluster number is found in the file or subdirectory’s directory entry.

Internal Logical Cache

FileX maintains a *most-recently-used* logical sector cache for each opened media. The maximum size of the logical sector cache is defined by the constant ***FX_MAX_SECTOR_CACHE*** and is located in ***fx_api.h***. This is the first factor determining the size of the internal logical sector cache.

The other factor that determines the size of the logical sector cache is the amount of memory supplied to the ***fx_media_open*** call by the application. There must be enough memory for at least one logical sector. If more than ***FX_MAX_SECTOR_CACHE*** logical sectors are required, the constant must be changed in ***fx_api.h*** and the entire FileX library must be rebuilt.

Each opened media in FileX may have a different cache size depending on the memory supplied during the open call.

Write Protect

FileX provides the application driver the ability to dynamically set write protection on the media. If write protection is required, the driver sets to FX_TRUE the ***fx_media_driver_write_protect*** field in the associated FX_MEDIA structure. When set, all attempts by the application to modify the media are rejected as well as attempts to open files for writing. The driver may also disable write protection by clearing this field.

Free Sector Update

FileX provides a mechanism to inform the application driver when sectors are no longer in use. This is especially useful for FLASH memory managers that manage all logical sectors being used by FileX.

If notification of free sectors is required, the application driver sets to FX_TRUE the ***fx_media_driver_free_sector_update*** field in the associated FX_MEDIA structure. This assignment is typically done during driver initialization.

Setting this field, FileX makes a ***FX_DRIVER_RELEASE_SECTORS*** driver call indicating when one or more consecutive sectors become free.

Media Control Block FX_MEDIA

The characteristics of each open media in FileX are contained in the media control block. This structure is defined in the ***fx_api.h*** file.

The media control block can be located anywhere in memory, but it is most common to make the control block a global structure by defining it outside the scope of any function.

Locating the control block in other areas requires a bit more care, just like all dynamically allocated memory. If a control block is allocated within a C function, the memory associated with it is part of the calling thread's stack.

In general, avoid using local storage for control blocks because after the function returns, all of its local variable stack space is released—regardless of whether it is still in use!

FAT12/16/32 Directory Description

FileX supports both 8.3 and Windows Long File Name (LFN) name formats. In addition to the name, each directory entry contains the entry's attributes, the last modified time and date, the starting cluster index, and the size in bytes of the entry. Table 3 on page 48 shows the contents and size of a FileX 8.3 directory entry.

Directory Name: FileX supports file names ranging in size from 1 to 255 characters. Standard eight-character file names are represented in a single directory entry on the media. They are left justified in the directory name field and are blank padded. In addition, the ASCII characters that comprise the name are always capitalized.

Long File Names (LFNs) are represented by consecutive directory entries, in reverse order, followed immediately by an 8.3 standard file name. The created 8.3 name contains all the meaningful directory information associated with the name. Table 4 on page 50 shows the contents of the directory entries used to hold the Long File Name information, and Table 5 on page 52 shows an

TABLE 3. FileX 8.3 Directory Entry

Offset	Field	Number of Bytes
0x00	Directory Entry Name	8
0x08	Directory Extension	3
0x0B	Attributes	1
0x0C	NT (introduced by the long file name format and is reserved for NT [always 0])	1
0x0D	Created Time in milliseconds (introduced by the long file name format and represents the number of milliseconds when the file was created.)	1
0x0E	Created Time in hours & minutes (introduced by the long file name format and represents the hour and minute the file was created)	2
0x10	Created Date (introduced by the long file name format and represents the date the file was created.)	2
0x12	Last Accessed Date (introduced by the long file name format and represents the date the file was last accessed.)	2
0x14	Starting Cluster (Upper 16 bits FAT-32 only)	2
0x16	Modified Time	2
0x18	Modified Date	2
0x1A	Starting Cluster (Lower 16 bits FAT-32 or FAT-12 or FAT-16)	2

example of a 39-character LFN that requires a total of four directory entries.

*The constant **FX_MAX_LONG_NAME_LEN**, defined in **fx_api.h**, contains the maximum length supported by FileX.*

Directory Filename Extension: For standard 8.3 file names, FileX also supports the optional three-character *directory filename extension*. Just like the eight-character file name, filename extensions are left justified in the directory filename extension field, blank padded, and always capitalized.

Directory Attributes: The one-byte *directory attribute* field entry contains a series of bits that specify various properties of the directory entry. Directory attribute definitions are as follow:

Attribute Bit	Meaning
0x01	Entry is read-only.
0x02	Entry is hidden.
0x04	Entry is a system entry.
0x08	Entry is a volume label
0x10	Entry is a directory.
0x20	Entry has been modified.

Because all the attribute bits are mutually exclusive, there may be more than one attribute bit set at a time.

Directory Time: The two-byte *directory time* field contains the hours, minutes, and seconds of the last change to the specified directory entry. Bits 15 through 11 contain the hours, bits 10 though 5 contain the minutes, and bits 4 though 0 contain the half seconds. Actual seconds are divided by two before being written into this field.

Directory Date: The two-byte *directory date* field contains the year (offset from 1980), month, and day of the last change to the specified directory entry. Bits

15 through 9 contain the year offset, bits 8 through 5 contain the month offset, and bits 4 through 0 contain the day.

Directory Starting Cluster: This field occupies 2 bytes for FAT-12 and FAT-16. For FAT-32 this field occupies 4 bytes. This field contains the first cluster number allocated to the entry (subdirectory or file).

Note that FileX creates new files without an initial cluster (starting cluster field equal to zero) to allow users to optionally allocate a contiguous number of clusters for a newly created file.

Directory File Size: The four-byte *directory file size* field contains the number of bytes in the file. If the entry is really a subdirectory, the size field is zero.

Long File Name Directory

TABLE 4. Long File Name Directory Entry

Offset	Field	Number of Bytes
0x00	Ordinal Field	1
0x01	Unicode Character 1	2
0x03	Unicode Character 2	2
0x05	Unicode Character 3	2
0x07	Unicode Character 4	2
0x09	Unicode Character 5	2
0x0B	LFN Attributes	1
0x0C	LFN Type (Reserved always 0)	1
0x0D	LFN Checksum	1

TABLE 4. Long File Name Directory Entry

Offset	Field	Number of Bytes
0x0E	Unicode Character 6	2
0x10	Unicode Character 7	2
0x12	Unicode Character 8	2
0x14	Unicode Character 9	2
0x16	Unicode Character 10	2
0x18	Unicode Character 11	2
0x1A	LFN Cluster (unused always 0)	2
0x1C	Unicode Character 12	2
0x1E	Unicode Character 13	2

Ordinal: The one-byte *ordinal* field that specifies the number of the LFN entry. Because LFN entries are positioned in reverse order, the ordinal values of the LFN directory entries comprising a single LFN decrease by one. In addition, the ordinal value of the LFN directly before the 8.3 file name must be one.

Unicode Character: The two-byte *Unicode Character* fields are designed to support characters from many different languages. Standard ASCII characters are represented with the ASCII character stored in the first byte of the Unicode character followed by a space character.

LFN Attributes: The one-byte *LFN Attributes* field contains attributes that identify the directory entry as an LFN directory entry. This is accomplished by having the read-only, system, hidden, and volume attributes all set.

LFN Type: The one-byte *LFN Type* field is reserved and is always 0.

LFN Checksum: The one-byte *LFN Checksum* field represents a checksum of the 11 characters of the associated MS-DOS 8.3 file name. This checksum is stored in each LFN entry to help ensure the LFN entry corresponds to the appropriate 8.3 file name.

LFN Cluster: • The two-byte *LFN Cluster* field is unused and is always 0.

TABLE 5. Directory Entries Comprising a 39-Character LFN

Entry	Meaning
1	LFN Directory Entry 3
2	LFN Directory Entry 2
3	LFN Directory Entry 1
4	8.3 Directory Entry

exFAT Directory Description

exFAT file system stores directory entry and file name differently. Directory entry contains the entry's attributes, various timestamps on when the entry was created, modified, and accessed. Other information, such as file size and starting cluster, is stored in Stream Extension Directory Entry which immediately follows the primary directory entry. exFAT supports only Long File Name (LFN) name format. which is stored in File Name Directory Entry immediately follows the Stream Extension Directory Entry, as shown in Table 2 on page 40.

exFAT File Directory Entry

A description of exFAT file directory entry and its contents is included in the following table and paragraphs..

TABLE 6. exFAT File Directory Entry

Offset	Field	Number of Bytes
0x00	Entry Type	1
0x01	Secondary Entry Count	1
0x02	Checksum	2
0x04	File Attributes	2
0x06	Reserved 1	2
0x08	Create Timestamp	4
0x0C	Last Modified Timestamp	4
0x10	Last Accessed Timestamp	4
0x14	Create 10ms Increment	1
0x15	Last Modified 10ms Increment	1
0x16	Create UTC Offset	1
0x17	Last Modified UTC Offset	1
0x18	Last Access UTC Offset	1
0x19	Reserved 2	7

Entry Type: The entry type field indicates the type of this entry. For File Directory Entry, this field must be 0x85.

Secondary Entry Count: The *secondary entry count* field indicates the number of secondary entries immediately follows this primary entry. Secondary entries associated with the file directory entry include one stream extension directory entry and one or more file name directory entries.

Checksum: The *checksum* field contains the value of the checksum over all entries in the directory entry set (the file directory entry and its secondary entries).

File Attributes: The one-byte attributes field entry contains a series of bits that specify various properties of the directory entry. The definition of most attributes bits is identical to FAT 12/16/32. Directory attribute definitions are as follows:

Attribute Bit	**Meaning**
0x01	Entry is read-only.
0x02	Entry is hidden.
0x04	Entry is a system entry.
0x08	Entry is reserved.
0x10	Entry is a directory.
0x20	Entry has been modified.
All other bits	Reserved

Reserved1: This field should be zero.

Create Timestamp: The *create timestamp* field, combining information from the *create 10ms Increment* field, describes the local date and time the file or the directory was created.

Last Modified Timestamp: The *last modified timestamp* field, combining information from the *last modified 10ms increment* field, describe the local date and time the file or the directory was last modified. See notes below on timestamps.

Last Accessed Timestamp: The *last accessed timestamp* field describes the local date and time the file or the directory was last accessed. See notes below on timestamps.

Create 10ms Increment: The *create 10ms increment* field, combining information from the *create timestamp* field, describes the local date and time the file or the directory was created. See notes below on timestamps.

Last Modified 10ms Increment: The *last modified 10ms increment* field, combining information from the *last modified timestamp* field, describe the local date and time the file or the directory was last modified. See notes below on timestamps.

Create UTC Offset: The *create UTC offset* field describes the difference between the local time and the UTC time, when the file or the directory was created. See notes below on timestamps.

Last Modified UTC Offset: The *last modified UTC offset* field describes the difference between the local time and the UTC time, when the file or the directory was last modified. See notes below on timestamps.

Last Accessed UTC Offset: The *last accessed UTC offset* field describes the difference between the local time and the UTC time, when the file or the directory was last accessed. See notes below on timestamps.

Reserved2: This field should be zero.

Notes on Timestamps

Timestamp Entry: The timestamp fields are interpreted as follows:

10ms Increment Fields

The value in the 10ms increment field provides finer granularity to the timestamp value. The valid values are between 0 (0ms) and 199 (1990ms).

31 25 21 16 11 5 0

Year (Relative to year 1980)	Month: 1-12	Day: 1-31	Hour: 0-23	Minute: 0-59	Seconds divide by 2 (0-29)

UTC Offset Field

7 6 0

Valid	Offset Value

Offset Value

7-bit signed integer represents offset from UTC time, in 15 minutes increments.

Valid

Whether or not the value in the offset field is valid. 0 indicates the value in the offset value field is invalid. 1 indicates the value is valid.

Stream Extension Directory Entry

A description of Stream Extension Directory Entry and its contents is included in the following table.

TABLE 7. Stream Extension Directory Entry

Offset	Field	Number of Bytes
0x00	Entry Type	1
0x01	Flags	1
0x02	Reserved 1	1
0x03	Name Length	1
0x04	Name Hash	2
0x06	Reserved 2	2

TABLE 7. Stream Extension Directory Entry

0x08	Valid Data Length	8
0x10	Reserved 3	4
0x14	First Cluster	4
0x18	Data Length	8

Entry Type: The *entry type* field indicates the type of this entry. For streaming extension Directory Entry, this field must be 0xC0.

Flags: This field contains a series of bits that specify various properties:

Flag Bit	Meaning
0x01	This field indicates whether or not allocation of clusters is possible. This field should be 1.
0x02	This field indicates whether or not the associated clusters are contiguous. A value 0 means the FAT entry is valid and FileX shall follow the FAT chain. A value 1 means the FAT entry is invalid and the clusters are contiguous.
All other bits	Reserved

Reserved 1: This field should be 0.

Name Length: The *name length* field contains the length of the unicode string in the file name directory entries collectively contain. The file name directory entries shall immediately follow this stream extension directory entry.

Name Hash: The *name hash* field is a 2-byte entry, containing the hash value of the up-cased file name. The hash value allows faster file/directory name lookup: if the hash values don't match, the file name associated with this entry is not a match.

Reserved 2: This field should be 0.

Valid Data Length: The *valid data length* field indicates the amount of valid data in the file.

Reserved 3: This filed should be 0.

First Cluster: The *first cluster* field contains index of the first cluster of the data stream.

Data Length: The *data length* field contains the total number of bytes in the allocated clusters. This value may be larger than *Valid Data Length*, since exFAT allows pre-allocation of data clusters.

Root Directory

In FAT 12- and 16-bit formats, the *root directory* is located immediately after all the FAT sectors in the media and can be located by examining the ***fx_media_root_sector_start*** in an opened ***FX_MEDIA*** control block. The size of the root directory, in terms of number of directory entries (each 32 bytes in size), is determined by the corresponding entry in the media's boot record.

The root directory in FAT-32 and exFAT can be located anywhere in the available clusters. Its location and size are determined from the boot record when the media is opened. After the media is opened, the ***fx_media_root_sector_start*** field can be used to find the starting cluster of the FAT-32 or exFAT root directory.

Subdirectories

There is any number of subdirectories in an FAT system. The name of the subdirectory resides in a directory entry just like a file name. However, the directory attribute specification (0x10) is set to indicate the entry is a subdirectory and the file size is always zero.

Figure 3 on page 62 shows what a typical subdirectory structure looks like for a new single-cluster subdirectory named ***SAMPLE.DIR*** with one file called ***FILE.TXT***.

In most ways, subdirectories are very similar to file entries. The first cluster field points to the first cluster of a linked list of clusters. When a subdirectory is created, the first two directory entries contain default directories, namely the "." directory and the ".." directory. The "." directory points to the subdirectory itself, while the ".." directory points to the previous or parent directory.

Global Default Path

FileX provides a global default path for the media. The default path is used in any file or directory service that does not explicitly specify a full path.

Initially, the global default directory is set to the media's root directory. This may be changed by the application by calling ***fx_directory_default_set***.

The current default path for the media may be examined by calling ***fx_directory_default_get***. This routine provides a string pointer to the default path string maintained inside of the ***FX_MEDIA*** control block.

Local Default Path

FileX also provides a thread-specific default path that allows different threads to have unique paths without conflict. The ***FX_LOCAL_PATH*** structure is supplied by the application during calls to ***fx_directory_local_path_set*** and ***fx_directory_local_path_restore*** to modify the local path for the calling thread.

If a local path is present, the local path takes precedence over the global default media path. If the local path is not setup or if it is cleared with the ***fx_directory_local_path_clear*** service, the media's global default path is used once again.

File Description

FileX supports standard 8.3 character and long file names with three-character extensions. In addition to the ASCII name, each file entry contains the entry's attributes, the last modified time and date, the starting cluster index, and the size in bytes of the entry.

File Allocation

FileX supports the standard cluster allocation scheme of the FAT format. In addition, FileX supports pre-cluster allocation of contiguous clusters. To accommodate this, each FileX file is created with no allocated clusters. Clusters are allocated on subsequent write requests or on ***fx_file_allocate*** requests to pre-allocate contiguous clusters.

Figure 4, "FileX FAT-16 File Example," on page 64 shows a file named ***FILE.TXT*** with two sequential clusters allocated starting at cluster 101, a size of 26, and the alphabet as the data in the file's first data cluster number 101.

File Access

A FileX file may be opened multiple times simultaneously for read access. However, a file can only be opened once for writing. The information used to support the file access is contained in the ***FX_FILE*** file control block.

Note that the media driver can dynamically set write protection. If this happens all write requests are rejected as well as attempts to open a file for writing.

File Layout in exFAT

The design of exFAT does not require FAT chain to be maintained for a file if data is stored in contagious clusters. The *NoFATChain* bit in the Stream Extension Directory Entry indicates whether or not the FAT chain should be used when reading data from the file. If the *NoFATChain* is set, FileX reads sequentially from the cluster indicated in the *First Cluster* field in the Stream Extension Directory Entry.

On the other hand, if the *NoFATChain* is clear, FileX will follow the FAT chain in order to traverse the entire file, similar to the FAT chain in FAT12/16/32.

Figure 3 shows two sample files, one does not require FAT chain, and the other one requires a FAT chain.

System Information

FileX system information consists of keeping track of the open media instances and maintaining the global system time and date.

By default, the system date and time are set to the last release date of FileX. To have accurate system date and time, the application must call

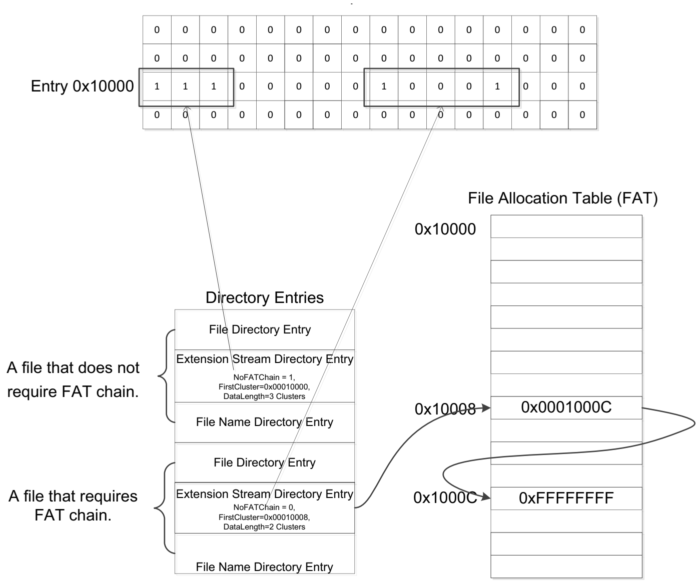

FIGURE 3. File with Contiguous Clusters vs. File Requiring FAT Link

fx_system_time_set and ***fx_system_date_set*** during initialization.

System Date

The FileX system date is maintained in the global ***_fx_system_date*** variable. Bits 15 through 9 contain the year offset from 1980, bits 8 through 5 contain the month offset, and bits 4 through 0 contain the day.

System Time

The FileX system time is maintained in the global ***_fx_system_time*** variable. Bits 15 through 11 contain the hours, bits 10 though 5 contain the minutes, and bits 4 though 0 contain the half seconds.

Periodic Time Update

During system initialization, FileX creates a ThreadX application timer to periodically update the system date and time. The rate at which the system date and time update is determined by two constants used by the ***_fx_system_initialize*** function.

The constants ***FX_UPDATE_RATE_IN_SECONDS*** and ***FX_UPDATE_RATE_IN_TICKS*** represent the same period of time. The constant ***FX_UPDATE_RATE_IN_TICKS*** is the number of ThreadX timer ticks that represents the number of seconds specified by the constant ***FX_UPDATE_RATE_IN_SECONDS***. The ***FX_UPDATE_RATE_IN_SECONDS*** constant specifies how many seconds between each FileX time update. Therefore, the internal FileX time increments in intervals of ***FX_UPDATE_RATE_IN_SECONDS***. These constants may be supplied during compilation of ***fx_system_initialize.c*** or the user may modify the defaults found in the ***fx_port.h*** file of the FileX release.

The periodic FileX timer is used only for updating the global system date and time, which is used solely for file time-stamping. If time-stamping is not necessary, simply define ***FX_NO_TIMER*** when compiling ***fx_system_initialize.c*** to eliminate the creation of the FileX periodic timer.

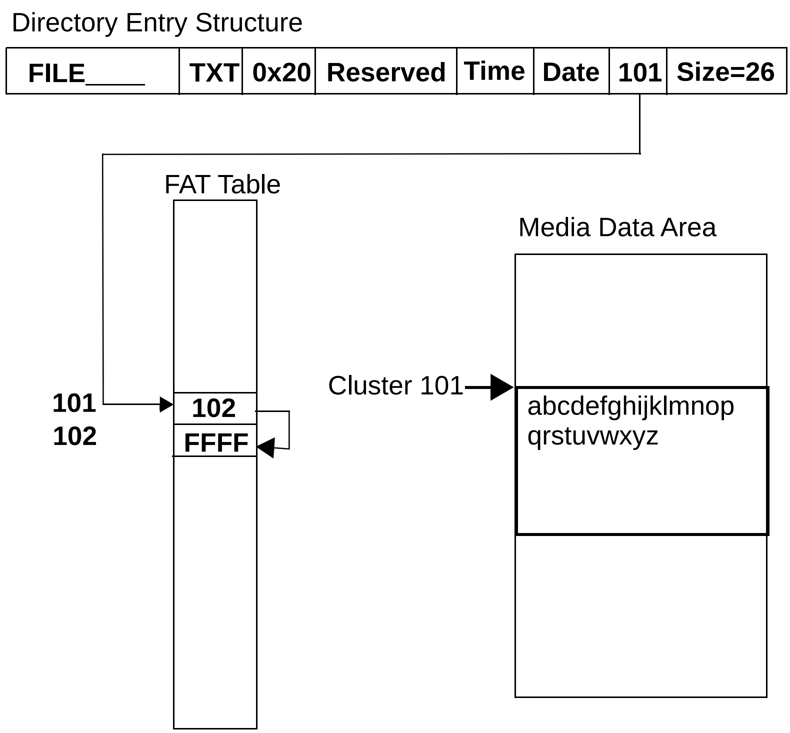

FIGURE 4. FileX FAT-16 File Example

Chapter 4: Description of FileX Services

This chapter contains a description of all Azure RTOS *FileX* services in alphabetic order. Service names are designed so all similar services are grouped together. For example, all file services are found at the beginning of this chapter.

fx_unicode_name_get_extended 232
Gets Unicode name from short name

fx_unicode_short_name_get 234
Gets short name from Unicode name

fx_unicode_short_name_get_extended 236
Gets short name from Unicode name

fx_directory_attributes_read

Reads directory attributes

Prototype

```
UINT  fx_directory_attributes_read(FX_MEDIA *media_ptr,
                                   CHAR *directory_name,
                                   UINT *attributes_ptr)
```

Description

This service reads the directory's attributes from the specified media.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to the name of the requested directory (directory path is optional).
attributes_ptr	Pointer to the destination for the directory's attributes to be placed. The directory attributes are returned in a bit-map format with the following possible settings:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)
FX_VOLUME	(0x08)
FX_DIRECTORY	(0x10)
FX_ARCHIVE	(0x20)

Return Values

FX_SUCCESS	(0x00)	Successful directory attributes read.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX _NOT FOUND	(0x04)	Specified directory was not found in the media.
FX_NOT_DIRECTORY	(0x0E)	Entry is not a directory.

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Retrieve the attributes of "mydir" from the specified media. */
status =  fx_directory_attributes_read(&my_media,
                "mydir", &attributes);

/* If status equals FX_SUCCESS, "attributes" contains the directory
   attributes of "mydir". */
```

See Also

fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_attributes_set

Sets directory attributes

Prototype

```
UINT  fx_directory_attributes_set(FX_MEDIA *media_ptr,
                                  CHAR *directory_name, UINT *attributes)
```

Description

This service sets the directory's attributes to those specified by the caller.

This application is only allowed to modify a subset of the directory's attributes with this service. Any attempt to set additional attributes will result in an error.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to the name of the requested directory (directory path is optional).
attributes	The new attributes to this directory. The valid directory attributes are defined as follows:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)
FX_ARCHIVE	(0x20)

Return Values

FX_SUCCESS	(0x00)	Successful directory attribute set.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX _NOT FOUND	(0x04)	Specified directory was not found in the media.
FX_NOT_DIRECTORY	(0x0E)	Entry is not a directory.
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_INVALID_ATTR	(0x19)	Invalid attributes selected.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Set the attributes of "mydir" to read-only. */
status =  fx_directory_attributes_set(&my_media,
                "mydir", FX_READ_ONLY);

/* If status equals FX_SUCCESS, the directory "mydir" is read-only.
*/
```

See Also

fx_directory_attributes_read, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_create

Creates subdirectory

Prototype

```
UINT fx_directory_create(FX_MEDIA *media_ptr, CHAR *directory_name)
```

Description

This service creates a subdirectory in the current default directory or in the path supplied in the directory name. Unlike the root directory, subdirectories do not have a limit on the number of files they can hold. The root directory can only hold the number of entries determined by the boot record.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to the name of the directory to create (directory path is optional).

Return Values

FX_SUCCESS	(0x00)	Successful directory create.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified directory already exists.
FX_NO_MORE_SPACE	(0x0A)	No more clusters available in the media for the new directory entry.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_INVALID_PATH	(0x0D)	Specified path is not valid.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_NOT_FOUND	(0x04)	Entry not found
FX_INVALID_NAME	(0x0C)	Specified name is not valid.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Create a subdirectory called "temp" in the current
   default directory. */
   status = fx_directory_create(&my_media, "temp");

/* If status equals FX_SUCCESS, the new subdirectory "temp"
   has been created. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_default_get

Gets last default directory

Prototype

```
UINT fx_directory_default_get(FX_MEDIA *media_ptr, CHAR **return_path_name)
```

Description

This service returns the pointer to the path last set by ***fx_directory_default_set***. If the default directory has not been set or if the current default directory is the root directory, a value of FX_NULL is returned.

*The default size of the internal path string is 256 characters; it can be changed by modifying **FX_MAXIMUM_PATH** in **fx_api.h** and rebuilding the entire FileX library. The character string path is maintained for the application and is not used internally by FileX.*

Input Parameters

media_ptr	Pointer to a media control block.
return_path_name	Pointer to the destination for the last default directory string. A value of FX_NULL is returned if the current setting of the default directory is the root. When the media is opened, root is the default.

Return Values

FX_SUCCESS	(0x00)	Successful default directory get.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_PTR_ERROR	(0x18)	Invalid media or destination pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
CHAR            *current_default_dir;
UINT            status;

/* Retrieve the current default directory. */
   status = fx_directory_default_get(&my_media,
   &current_default_dir);

/* If status equals FX_SUCCESS, "current_default_dir"
   contains a pointer to the current default directory). */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_default_set

Sets default directory

Prototype

```
UINT fx_directory_default_set(FX_MEDIA *media_ptr, CHAR *new_path_name)
```

Description

This service sets the default directory of the media. If a value of FX_NULL is supplied, the default directory is set to the media's root directory. All subsequent file operations that do not explicitly specify a path will default to this directory.

i *The default size of the internal path string is 256 characters; it can be changed by modifying **FX_MAXIMUM_PATH** in **fx_api.h** and rebuilding the entire FileX library. The character string path is maintained for the application and is not used internally by FileX.*

i *For names supplied by the application, FileX supports both backslash (\) and forward slash (/) characters to separate directories, subdirectories, and file names. However, FileX only uses the backslash character in paths returned to the application.*

Input Parameters

media_ptr	Pointer to a media control block.
new_path_name	Pointer to new default directory name. If a value of FX_NULL is supplied, the default directory of the media is set to the media's root directory.

Return Values

FX_SUCCESS	(0x00)	Successful default directory set.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_INVALID_PATH	(0x0D)	New directory could not be found.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Set the default directory to \abc\def\ghi. */
status = fx_directory_default_set(&my_media,
                          "\\abc\\def\\ghi");

/* If status equals FX_SUCCESS, the default directory for
   this media is \abc\def\ghi. All subsequent file operations
   that do not explicitly specify a path will default to this
   directory. Note that the character "\" serves as an escape
   character in a string. To represent the character "\", use the
   construct "\\". This is done because of the C language - only one
   "\" is really present in the string. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_delete

Deletes subdirectory

Prototype

```
UINT fx_directory_delete(FX_MEDIA *media_ptr, CHAR *directory_name)
```

Description

This service deletes the specified directory. Note that the directory must be empty to delete it.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to name of directory to delete (directory path is optional).

Return Values

FX_SUCCESS	(0x00)	Successful directory delete.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Specified directory was not found.
FX_DIR_NOT_EMPTY	(0x10)	Specified directory is not empty.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_NOT_DIRECTORY	(0x0E)	Not a directory entry.

FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Delete the subdirectory "abc." */
   status = fx_directory_delete(&my_media, "abc");

/* If status equals FX_SUCCESS, the subdirectory "abc"
   was deleted. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_first_entry_find

Gets first directory entry

Prototype

```
UINT fx_directory_first_entry_find(FX_MEDIA *media_ptr,
                                   CHAR *return_entry_name)
```

Description

This service retrieves the first entry name in the default directory and copies it to the specified destination.

*The specified destination must be large enough to hold the maximum sized FileX name, as defined by **FX_MAX_LONG_NAME_LEN.***

If using a non-local path, it is important to prevent (with a ThreadX semaphore, mutex, or priority level change) other application threads from changing this directory while a directory traversal is taking place. Otherwise, invalid results may be obtained.

Input Parameters

media_ptr	Pointer to a media control block.
return_entry_name	Pointer to destination for the first entry name in the default directory.

Return Values

FX_SUCCESS	(0x00)	Successful first directory entry find.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;
CHAR            entry[FX_MAX_LONG_NAME_LEN];

/* Retrieve the first directory entry in the current
   directory. */
status = fx_directory_first_entry_find(&my_media, entry);

/* If status equals FX_SUCCESS, the entry in the directory
   is the "entry" string. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_first_full_entry_find

Gets first directory entry with full information

Prototype

```
UINT fx_directory_first_full_entry_find(FX_MEDIA *media_ptr,
                                        CHAR *directory_name,
                                        UINT *attributes,
                                        ULONG *size,
                                        UINT *year, UINT *month, UINT *day,
                                        UINT *hour, UINT *minute,
                                        UINT *second)
```

Description

This service retrieves the first entry name in the default directory and copies it to the specified destination. It also returns full information about the entry as specified by the additional input parameters.

*The specified destination must be large enough to hold the maximum sized FileX name, as defined by **FX_MAX_LONG_NAME_LEN.***

If using a non-local path, it is important to prevent (with a ThreadX semaphore, mutex, or priority level change) other application threads from changing this directory while a directory traversal is taking place. Otherwise, invalid results may be obtained.

Input Parameters

media_ptr Pointer to a media control block.

directory_name Pointer to the destination for the name of a directory entry. Must be at least as big as ***FX_MAX_LONG_NAME_LEN***.

attributes If non-null, pointer to the destination for the entry's attributes to be placed. The attributes are returned in a bit-map format with the following possible settings:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)

FX_VOLUME	(0x08)
FX_DIRECTORY	(0x10)
FX_ARCHIVE	(0x20)

size	If non-null, pointer to the destination for the entry's size in bytes.
year	If non-null, pointer to the destination for the entry's year of modification.
month	If non-null, pointer to the destination for the entry's month of modification.
day	If non-null, pointer to the destination for the entry's day of modification.
hour	If non-null, pointer to the destination for the entry's hour of modification.
minute	If non-null, pointer to the destination for the entry's minute of modification.
second	If non-null, pointer to the destination for the entry's second of modification.

Return Values

FX_SUCCESS	(0x00)	Successful directory first entry find.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_MEDIA_INVALID	(0x02)	Invalid media.

FX_PTR_ERROR	(0x18)	Invalid media pointer or all input parameters are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;
CHAR            entry_name[FX_MAX_LONG_NAME_LEN];
UINT            attributes;
ULONG           size;
UINT            year;
UINT            month;
UINT            day;
UINT            hour;
UINT            minute;
UINT            second;

/* Get the first directory entry in the default directory with full
   information. */
status = fx_directory_first_full_entry_find(&my_media,
                entry_name, &attributes, &size, &year, &month,
                &day, &hour, &minute, &second);

/* If status equals FX_SUCCESS, the entry's information is in the
   local variables. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_information_get

Gets directory entry information

Prototype

```
UINT fx_directory_information_get(FX_MEDIA *media_ptr,
                                  CHAR *directory_name, UINT *attributes,
                                  ULONG *size,
                                  UINT *year, UINT *month, UINT *day,
                                  UINT *hour, UINT *minute, UINT *second)
```

Description

This service retrieves a variety of information about the specified directory entry. If any field is FX_NULL, it is not updated.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to name of the directory entry.
attributes	Pointer to the destination for the attributes.
size	Pointer to the destination for the size.
year	Pointer to the destination for the year.
month	Pointer to the destination for the month.
day	Pointer to the destination for the day.
hour	Pointer to the destination for the hour.
minute	Pointer to the destination for the minute.
second	Pointer to the destination for the second.

Return Values

FX_SUCCESS	(0x00)	Successful default directory information get.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Directory entry could not be found.
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_PTR_ERROR	(0x18)	Invalid media pointer or all input parameters are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA          my_media;
UINT              status, attributes, year, month, day;
UINT              hour, minute, second;
ULONG             size;
/* Retrieve information about the directory entry
   "myfile.txt".*/
status = fx_directory_information_get(&my_media, "myfile.txt",
                  &attributes,
                            &size, &year, &month, &day,
                            &hour, &minute, &second);

/* If status equals FX_SUCCESS, the directory entry
   information is available in the local variables. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_local_path_clear

Clears default local path

Prototype

```
UINT fx_directory_local_path_clear(FX_MEDIA *media_ptr)
```

Description

This service clears the previous local path set up for the calling thread.

Input Parameters

media_ptr Pointer to a previously opened media.

Return Values

FX_SUCCESS	(0x00)	Successful local path clear.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not currently open.
FX_NOT_IMPLEMENTED	(0x22)	*FX_NO_LCOAL_PATH* is defined.
FX_PTR_ERROR	(0x18)	Invalid media pointer.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Clear the previously setup local path for this media. */
status = fx_directory_local_path_clear(&my_media);

/* If status equals FX_SUCCESS the local path is cleared. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_local_path_get

Gets the current local path string

Prototype

```
UINT fx_directory_local_path_get(FX_MEDIA *media_ptr,
                                 CHAR **return_path_name)
```

Description

This service returns the local path pointer of the specified media. If there is no local path set, a NULL is returned to the caller.

Input Parameters

media_ptr	Pointer to a media control block.
return_path_name	Pointer to the destination string pointer for the local path string to be stored.

Return Values

FX_SUCCESS	(0x00)	Successful local path get.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not currently open.
FX_NOT_IMPLEMENTED	(0x22)	*NX_NO_LOCAL_PATH* is defined.
FX_PTR_ERROR	(0x18)	Invalid media pointer.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;
CHAR             *my_path;
UINT             status;

/* Retrieve the current local path string. */
status = fx_directory_local_path_get(&my_media, &my_path);

/* If status equals FX_SUCCESS, "my_path" points to the
   local path string. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_local_path_restore

Restores previous local path

Prototype

```
UINT fx_directory_local_path_restore(FX_MEDIA *media_ptr,
                                     FX_LOCAL_PATH *local_path_ptr)
```

Description

This service restores a previously set local path. The directory search position made on this local path is also restored, which makes this routine useful in recursive directory traversals by the application.

*Each local path contains a local path string of **FX_MAXIMUM_PATH** in size, which by default is 256 characters. This internal path string is not used by FileX and is provided only for the application's use. If **FX_LOCAL_PATH** is going to be declared as a local variable, users should beware of the stack growing by the size of this structure. Users are welcome to reduce the size of **FX_MAXIMUM_PATH** and rebuild the FileX library source.*

Input Parameters

media_ptr	Pointer to a media control block.
local_path_ptr	Pointer to the previously set local path. It's very important to ensure that this pointer does indeed point to a previously used and still intact local path.

Return Values

FX_SUCCESS	(0x00)	Successful local path restore.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not currently open.
FX_NOT_IMPLEMENTED	(0x22)	*FX_NO_LOCAL_PATH* is defined.
FX_PTR_ERROR	(0x18)	Invalid media or local path pointer.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;
FX_LOCAL_PATH    my_previous_local_path;
UINT             status;
/* Restore the previous local path. */
status = fx_directory_local_path_restore(&my_media,
                 &my_previous_local_path);

/* If status equals FX_SUCCESS, the previous local path
   has been restored. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_local_path_set

Sets up a thread-specific local path

Prototype

```
UINT fx_directory_local_path_set(FX_MEDIA *media_ptr,
                                 FX_LOCAL_PATH *local_path_ptr,
                                 CHAR *new_path_name)
```

Description

This service sets up a thread-specific path as specified by the ***new_path_string***. After successful completion of this routine, the local path information stored in ***local_path_ptr*** will take precedence over the global media path for all file and directory operations made by this thread. This will have no impact on any other thread in the system

i *The default size of the local path string is 256 characters; it can be changed by modifying **FX_MAXIMUM_PATH** in **fx_api.h** and rebuilding the entire FileX library. The character string path is maintained for the application and is not used internally by FileX.*

i *For names supplied by the application, FileX supports both backslash (\) and forward slash (/) characters to separate directories, subdirectories, and file names. However, FileX only uses the backslash character in paths returned to the application.*

Input Parameters

media_ptr	Pointer to the previously opened media.
local_path_ptr	Destination for holding the thread-specific local path information. The address of this structure may be supplied to the local path restore function in the future.
new_path_name	Specifies the local path to setup.

Return Values

FX_SUCCESS	(0x00)	Successful default directory set.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.

FX_INVALID_PATH	(0x0D)	New directory could not be found.
FX_NOT_IMPLEMENTED	(0x22)	*FX_NO_LOCAL_PATH* is defined.
FX_PTR_ERROR	(0x18)	Invalid media or local path pointer.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Set the local path to \abc\def\ghi. */
status = fx_directory_local_path_set(&my_media,
                &local_path,
                "\\abc\\def\\ghi");

/* If status equals FX_SUCCESS, the default directory for
   this thread is \abc\def\ghi. All subsequent file operations
   that do not explicitly specify a path will default to this
   directory. Note that the character "\" serves as an escape
   character in a string. To represent the character "\", use
   the construct "\\".*/
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_long_name_get

Gets long name from short name

Prototype

```
UINT  fx_directory_long_name_get(FX_MEDIA *media_ptr,
                                 CHAR *short_name,
                                 CHAR *long_name)
```

Description

This service retrieves the long name (if any) associated with the supplied short (8.3 format) name. The short name can be either a file name or a directory name.

Input Parameters

media_ptr	Pointer to media control block.
short_name	Pointer to source short name (8.3 format).
long_name	Pointer to destination for the long name. If there is no long name, the short name is returned. Note that the destination for the long name must be large enough to hold FX_MAX_LONG_NAME_LEN characters.

Return Values

FX_SUCCESS	(0x00)	Successful long name get.
FX_NOT_FOUND	(0x04)	Short name was not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_PTR_ERROR	(0x18)	Invalid media or name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAmy_media;
UCHAR           my_long_name[FX_MAX_LONG_NAME_LEN];

/* Retrieve the long name associated with "TEXT~01.TXT". */
status =  fx_directory_long_name_get(&my_media, "TEXT~01.TXT",
my_long_name);

/* If status is FX_SUCCESS the long name was successfully
   retrieved.  */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_long_name_get_extended

Gets long name from short name

Prototype

```
UINT  fx_directory_long_name_get_extended(FX_MEDIA *media_ptr,
                                          CHAR *short_name,
                                          CHAR *long_name
                                          UINT long_file_name_buffer_length)
```

Description

This service retrieves the long name (if any) associated with the supplied short (8.3 format) name. The short name can be either a file name or a directory name.

Input Parameters

media_ptr	Pointer to media control block.
short_name	Pointer to source short name (8.3 format).
long_name	Pointer to destination for the long name. If there is no long name, the short name is returned. Note: Destination for the long name must be large enough to hold FX_MAX_LONG_NAME_LEN characters.
long_file_name_buffer_length	Length of the long name buffer.

Return Values

FX_SUCCESS	(0x00)	Successful long name get.
FX_NOT_FOUND	(0x04)	Short name was not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.

FX_PTR_ERROR	(0x18)	Invalid media or name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAmy_media;
UCHAR           my_long_name[FX_MAX_LONG_NAME_LEN];

/* Retrieve the long name associated with "TEXT~01.TXT". */
status =  fx_directory_long_name_get_extended(&my_media,
                 "TEXT~01.TXT", my_long_name),
sizeof(my_long_name));

/* If status is FX_SUCCESS the long name was successfully
   retrieved.  */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_name_test

Tests for directory

Prototype

```
UINT fx_directory_name_test(FX_MEDIA *media_ptr, CHAR *directory_name)
```

Description

This service tests whether or not the supplied name is a directory. If so, a FX_SUCCESS is returned.

Input Parameters

media_ptr	Pointer to a media control block.
directory_name	Pointer to name of the directory entry.

Return Values

FX_SUCCESS	(0x00)	Supplied name is a directory.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Directory entry could not be found.
FX_NOT_DIRECTORY	(0x0E)	Entry is not a directory.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Check to see if the name "abc" is directory. */
status = fx_directory_name_test(&my_media, "abc");

/* If status equals FX_SUCCESS, "abc" is a directory. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_next_entry_find

Picks up next directory entry

Prototype

```
UINT fx_directory_next_entry_find(FX_MEDIA *media_ptr,
                                  CHAR *return_entry_name)
```

Description

This service returns the next entry name in the current default directory.

If using a non-local path, it is also important to prevent (with a ThreadX semaphore or thread priority level) other application threads from changing this directory while a directory traversal is taking place. Otherwise, invalid results may be obtained.

Input Parameters

media_ptr	Pointer to a media control block.
return_entry_name	Pointer to destination for the next entry name in the default directory. The buffer this pointer points to must be large enough to hold the maximum size of FileX name, defined by ***FX_MAX_LONG_NAME_LEN***.

Return Values

FX_SUCCESS	(0x00)	Successful next entry find.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
CHAR            next_name[FX_MAX_LONG_NAME_LEN];
UINT            status;

/* Retrieve the next entry in the default directory. */
status = fx_directory_next_entry_find(&my_media, next_name);

/* If status equals TX_SUCCESS, the name of the next directory
   entry is in "next_name". */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_next_full_entry_find

Gets next directory entry with full information

Prototype

```
UINT fx_directory_next_full_entry_find(FX_MEDIA *media_ptr,
                              CHAR *directory_name, UINT *attributes,
                              ULONG *size,
                              UINT *year, UINT *month, UINT *day,
                              UINT *hour, UINT *minute, UINT *second)
```

Description

This service retrieves the next entry name in the default directory and copies it to the specified destination. It also returns full information about the entry as specified by the additional input parameters.

The specified destination must be large enough to hold the maximum sized FileX name, as defined by ***FX_MAX_LONG_NAME_LEN***

If using a non-local path, it is important to prevent (with a ThreadX semaphore, mutex, or priority level change) other application threads from changing this directory while a directory traversal is taking place. Otherwise, invalid results may be obtained.

Input Parameters

media_ptr Pointer to a media control block.

directory_name Pointer to the destination for the name of a directory entry. Must be at least as big as ***FX_MAX_LONG_NAME_LEN***.

attributes If non-null, pointer to the destination for the entry's attributes to be placed.The attributes are returned in a bit-map format with the following possible settings:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)
FX_VOLUME	(0x08)

FX_DIRECTORY	(0x10)
FX_ARCHIVE	(0x20)

size	If non-null, pointer to the destination for the entry's size in bytes.
month	If non-null, pointer to the destination for the entry's month of modification.
year	If non-null, pointer to the destination for the entry's year of modification.
day	If non-null, pointer to the destination for the entry's day of modification.
hour	If non-null, pointer to the destination for the entry's hour of modification.
minute	If non-null, pointer to the destination for the entry's minute of modification.
second	If non-null, pointer to the destination for the entry's second of modification.

Return Values

FX_SUCCESS	(0x00)	Successful directory next entry find.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_PTR_ERROR	(0x18)	Invalid media pointer or all input parameters are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;
CHAR            entry_name[FX_MAX_LONG_NAME_LEN];
UINT            attributes;
ULONG           size;
UINT            year;
UINT            month;
UINT            day;
UINT            hour;
UINT            minute;
UINT            second;

/* Get the next directory entry in the default directory with full
   information. */
status = fx_directory_next_full_entry_find(&my_media,
                entry_name, &attributes, &size, &year, &month,
                &day, &hour, &minute, &second);

/* If status equals FX_SUCCESS, the entry's information is in the
   local variables. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_rename

Renames directory

Prototype

```
UINT fx_directory_rename(FX_MEDIA *media_ptr, CHAR *old_directory_name,
                          CHAR *new_directory_name)
```

Description

This service changes the directory name to the specified new directory name. Renaming is also done relative to the specified path or the default path. If a path is specified in the new directory name, the renamed directory is effectively moved to the specified path. If no path is specified, the renamed directory is placed in the current default path.

Input Parameters

media_ptr	Pointer to media control block.
old_directory_name	Pointer to current directory name.
new_directory_name	Pointer to new directory name.

Return Values

FX_SUCCESS	(0x00)	Successful directory rename.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Directory entry could not be found.
FX_NOT_DIRECTORY	(0x0E)	Entry is not a directory.
FX_INVALID_NAME	(0x0C)	New directory name is invalid.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in this directory.
FX_INVALID_PATH	(0x0D)	Invalid path supplied with directory name
FX_ALREADY_CREATED	(0x0B)	Specified directory was already created.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Change the directory "abc" to "def". */
status = fx_directory_rename(&my_media, "abc", "def");

/* If status equals FX_SUCCESS, the directory was changed
   to "def". */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_short_name_get, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_short_name_get

Gets short name from a long name

Prototype

```
UINT  fx_directory_short_name_get(FX_MEDIA *media_ptr,
                                  CHAR *long_name, CHAR *short_name)
```

Description

This service retrieves the short (8.3 format) name associated with the supplied long name. The long name can be either a file name or a directory name.

Input Parameters

media_ptr	Pointer to media control block.
long_name	Pointer to source long name.
short_name	Pointer to destination short name (8.3 format). Note that the destination for the short name must be large enough to hold 14 characters.

Return Values

FX_SUCCESS	(0x00)	Successful short name get.
FX_NOT_FOUND	(0x04)	Long name was not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.

FX_PTR_ERROR	(0x18)	Invalid media or name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAmy_media;
UCHAR          my_short_name[14];

/* Retrieve the short name associated with "my_really_long_name". */
status =  fx_directory_short_name_get(&my_media,
   "my_really_long_name", my_short_name);

/* If status is FX_SUCCESS the short name was successfully
   retrieved.  */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_unicode_directory_create, fx_unicode_directory_rename

fx_directory_short_name_get_extended

Gets short name from a long name

Prototype

```
UINT  fx_directory_short_name_get_extended(FX_MEDIA *media_ptr,
                          CHAR *long_name, CHAR *short_name
                          UINT short_file_name_length)
```

Description

This service retrieves the short (8.3 format) name associated with the supplied long name. The long name can be either a file name or a directory name.

Input Parameters

media_ptr	Pointer to media control block.
long_name	Pointer to source long name.
short_name	Pointer to destination short name (8.3 format). Note: Destination for the short name must be large enough to hold 14 characters.
short_file_name_length	Length of short name buffer.

Return Values

FX_SUCCESS	(0x00)	Successful short name get.
FX_NOT_FOUND	(0x04)	Long name was not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.

FX_PTR_ERROR	(0x18)	Invalid media or name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UCHAR           my_short_name[14];

/* Retrieve the short name associated with "my_really_long_name". */
status =  fx_directory_short_name_get_extended(&my_media,
                "my_really_long_name",  my_short_name,
                sizeof(my_short_name));

/* If status is FX_SUCCESS the short name was successfully
   retrieved.  */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_unicode_directory_create, fx_unicode_directory_rename

fx_fault_tolerant_enable

Enables the fault tolerant service

Prototype

```
UINT fx_fault_tolerant_enable(FX_MEDIA *media_ptr,
                                  VOID *memory_buffer, UINT memory_size)
```

Description

This service enables the fault tolerant module. Upon starting, the fault tolerant module detects whether or not the file system is under FileX fault tolerant protection. If it is not, the service finds available sectors on the file system to store logs on file system transactions. If the file system is under FileX fault tolerant protection, it applies the logs to the file system to maintain its integrity.

Input Parameters

media_ptr	Pointer to a media control block.
memory_ptr	Pointer to a block of memory used by the fault tolerant module as scratch memory.
memory_size	The size of the scratch memory. In order for fault tolerant to work properly, the scratch memory size shall be at least 3072 bytes, and must be multiple of sector size.

Return Values

FX_SUCCESS	(0x00)	Successfully enabled fault tolerant.
FX_NOT_ENOUGH_MEMORY	(0x91)	memory size too small.
FX_BOOT_ERROR	(0x01)	Boot sector error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_NO_MORE_ENTRIES	(0x0F)	No more free cluster available.
FX_NO_MORE_SPACE	(0x0A)	Media associated with this file does not have enough available clusters.

FX_SECTOR_INVALID	(0x89)	Sector is invalid
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Initialization, threads

Example

```
/* Declare memory space used for fault tolerant. */
ULONG fault tolerant_memory[3072 / sizeof(ULONG)];

/* Enable fault tolerant. */
fx_fault_tolerant_enable(media_ptr, fault_tolerant_memory,
   sizeof(fault_tolerant_memory));
```

See Also

fx_system_initialize, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write

fx_file_allocate

Allocates space for a file

Prototype

```
UINT fx_file_allocate(FX_FILE *file_ptr, ULONG size)
```

Description

This service allocates and links one or more contiguous clusters to the end of the specified file. FileX determines the number of clusters required by dividing the requested size by the number of bytes per cluster. The result is then rounded up to the next whole cluster.

To allocate space beyond 4GB, application shall use the service *fx_file_extended_allocate*.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	Number of bytes to allocate for the file.

Return Values

FX_SUCCESS	(0x00)	Successful file allocation.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_FAT_READ_ERROR	(0x03)	Failed to read FAT entry.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
FX_NO_MORE_ENTRIES	(0x0F)	No more free cluster available.
FX_NO_MORE_SPACE	(0x0A)	Media associated with this file does not have enough available clusters.
FX_SECTOR_INVALID	(0x89)	Sector is invalid
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;

/* Allocate 1024 bytes to the end of my_file. */
status = fx_file_allocate(&my_file, 1024);

/* If status equals FX_SUCCESS the file now has one or
   more contiguous cluster(s) that can accommodate at least
   1024 bytes of user data. */
```

See Also

fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_attributes_read

Reads file attributes

Prototype

```
UINT fx_file_attributes_read(FX_MEDIA *media_ptr, CHAR *file_name,
                             UINT *attributes_ptr)
```

Description

This service reads the file's attributes from the specified media.

Input Parameters

media_ptr	Pointer to a media control block.
file_name	Pointer to the name of the requested file (directory path is optional).
attributes_ptr	Pointer to the destination for the file's attributes to be placed. The file attributes are returned in a bit-map format with the following possible settings:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)
FX_VOLUME	(0x08)
FX_DIRECTORY	(0x10)
FX_ARCHIVE	(0x20)

Return Values

FX_SUCCESS	(0x00)	Successful attribute read.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Specified file was not found in the media.
FX_NOT_A_FILE	(0x05)	Specified file is a directory.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media or attributes pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;
UINT            attributes;

/* Retrieve the attributes of "myfile.txt" from the
   specified media. */
status = fx_file_attributes_read(&my_media, "myfile.txt",
                &attributes);

/* If status equals FX_SUCCESS, "attributes" contains the
   file attributes for "myfile.txt". */
```

See Also

fx_file_allocate, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_attributes_set

Sets file attributes

Prototype

```
UINT fx_file_attributes_set(FX_MEDIA *media_ptr, CHAR *file_name,
                             UINT attributes)
```

Description

This service sets the file's attributes to those specified by the caller.

The application is only allowed to modify a subset of the file's attributes with this service. Any attempt to set additional attributes will result in an error.

Input Parameters

media_ptr	Pointer to a media control block.
file_name	Pointer to the name of the requested file (directory path is optional).
attributes	The new attributes for the file. The valid file attributes are defined as follows:

FX_READ_ONLY	(0x01)
FX_HIDDEN	(0x02)
FX_SYSTEM	(0x04)
FX_ARCHIVE	(0x20)

Return Values

FX_SUCCESS	(0x00)	Successful attribute set.
FX_ACCESS_ERROR	(0x06)	File is open and cannot have its attributes set.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_ENTRIES	(0x0F)	No more entries in the FAT table or exFAT cluster map.

FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_NOT_FOUND	(0x04)	Specified file was not found in the media.
FX_NOT_A_FILE	(0x05)	Specified file is a directory.
FX_SECTOR_INVALID	(0x89)	Sector is invalid
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_INVALID_ATTR	(0x19)	Invalid attributes selected.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Set the attributes of "myfile.txt" to read-only. */
status = fx_file_attributes_set(&my_media, "myfile.txt",
                                FX_READ_ONLY);

/* If status equals FX_SUCCESS, the file is now read-only. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_best_effort_allocate

Best effort to allocate space for a file

Prototype

```
UINT fx_file_best_effort_allocate(FX_FILE *file_ptr, ULONG size,
                                  ULONG *actual_size_allocated)
```

Description

This service allocates and links one or more contiguous clusters to the end of the specified file. FileX determines the number of clusters required by dividing the requested size by the number of bytes per cluster. The result is then rounded up to the next whole cluster. If there are not enough consecutive clusters available in the media, this service links the largest available block of consecutive clusters to the file. The amount of space actually allocated to the file is returned to the caller.

To allocate space beyond 4GB, application shall use the service *fx_file_extended_best_effort_allocate*.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	Number of bytes to allocate for the file.

Return Values

FX_SUCCESS	(0x00)	Successful best-effort file allocation.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
TX_NO_MORE_SPACE	(0x0A)	Media associated with this file does not have enough available clusters.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer or destination.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;
ULONG            actual_allocation;

/* Attempt to allocate 1024 bytes to the end
   of my_file. */
status =  fx_file_best_effort_allocate(&my_file,
                 1024, &actual_allocation);

/* If status equals FX_SUCCESS, the number of bytes
   allocated to the file is found in actual_allocation. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_close

Closes file

Prototype

```
UINT fx_file_close(FX_FILE *file_ptr)
```

Description

This service closes the specified file. If the file was open for writing and if it was modified, this service completes the file modification process by updating its directory entry with the new size and the current system time and date.

Input Parameters

file_ptr	Pointer to the previously opened file.

Return Values

FX_SUCCESS	(0x00)	Successful file close.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media or attributes pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;

/* Close the previously opened file "my_file". */
status = fx_file_close(&my_file);

/* If status equals FX_SUCCESS, the file was closed
   successfully. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_create

Creates file

Prototype

```
UINT fx_file_create(FX_MEDIA *media_ptr, CHAR *file_name)
```

Description

This service creates the specified file in the default directory or in the directory path supplied with the file name.

This service creates a file of zero length, i.e., no clusters allocated. Allocation will automatically take place on subsequent file writes or can be done in advance with the fx_file_allocate service or fx_file_extended_allocate for space beyond 4GB) service.

Input Parameters

media_ptr	Pointer to a media control block.
file_name	Pointer to the name of the file to create (directory path is optional).

Return Values

FX_SUCCESS	(0x00)	Successful file create.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified file was already created.
FX_NO_MORE_SPACE	(0x0A)	Either there are no more entries in the root directory or there are no more clusters available.
FX_INVALID_PATH	(0x0D)	Invalid path supplied with file name.
FX_INVALID_NAME	(0x0C)	File name is invalid.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Underlying media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or file name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;
/* Create a file called "myfile.txt" in the root or
   the default directory of the media. */
status = fx_file_create(&my_media, "myfile.txt");

/* If status equals FX_SUCCESS, a zero sized file
   named "myfile.txt". */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_date_time_set

Sets file date and time

Prototype

```
UINT  fx_file_date_time_set(FX_MEDIA *media_ptr, CHAR *file_name,
                            UINT year, UINT month, UINT day,
                            UINT hour, UINT minute, UINT second)
```

Description

This service sets the date and time of the specified file.

Input Parameters

media_ptr	Pointer to media control block.
file_name	Pointer to name of the file.
year	Value of year (1980-2107 inclusive).
month	Value of month (1-12 inclusive).
day	Value of day (1-31 inclusive).
hour	Value of hour (0-23 inclusive).
minute	Value of minute (0-59 inclusive).
second	Value of second (0-59 inclusive).

Return Values

FX_SUCCESS	(0x00)	Successful date/time set.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	File was not found.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.
FX_INVALID_YEAR	(0x12)	Year is invalid.
FX_INVALID_MONTH	(0x13)	Month is invalid.
FX_INVALID_DAY	(0x14)	Day is invalid.
FX_INVALID_HOUR	(0x15)	Hour is invalid.
FX_INVALID_MINUTE	(0x16)	Minute is invalid.
FX_INVALID_SECOND	(0x17)	Second is invalid.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;

/* Set the date/time of "my_file". */
status =  fx_file_date_time_set(&my_media, "my_file",
                1999, 12, 31, 23, 59, 59);

/* If status is FX_SUCCESS the file's date/time was successfully
   set.  /*
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_delete

Deletes file

Prototype

```
UINT fx_file_delete(FX_MEDIA *media_ptr, CHAR *file_name)
```

Description

This service deletes the specified file.

Input Parameters

media_ptr	Pointer to a media control block.
file_name	Pointer to the name of the file to delete (directory path is optional).

Return Values

FX_SUCCESS	(0x00)	Successful file delete.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Specified file was not found.
FX_NOT_A_FILE	(0x05)	Specified file name was a directory or volume.
FX_ACCESS_ERROR	(0x06)	Specified file is currently open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_MEDIA_INVALID	(0x02)	Invalid media.

FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Delete the file "myfile.txt". */
status = fx_file_delete(&my_media, "myfile.txt");

/* If status equals FX_SUCCESS, "myfile.txt" has been
   deleted. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_allocate

Allocates space for a file

Prototype

```
UINT fx_file_extended_allocate(FX_FILE *file_ptr, ULONG64 size)
```

Description

This service allocates and links one or more contiguous clusters to the end of the specified file. FileX determines the number of clusters required by dividing the requested size by the number of bytes per cluster. The result is then rounded up to the next whole cluster.

This service is designed for exFAT. The *size* parameter takes a 64-bit integer value, which allows the caller to pre-allocate space beyond 4GB range.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	Number of bytes to allocate for the file.

Return Values

FX_SUCCESS	(0x00)	Successful file allocation.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
TX_NO_MORE_SPACE	(0x0A)	Media associated with this file does not have enough available clusters.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;

/* Allocate 0x100000000 bytes to the end of my_file. */
status = fx_file_extended_allocate(&my_file, 0x100000000);

/* If status equals FX_SUCCESS the file now has one or
   more contiguous cluster(s) that can accommodate at least
   1024 bytes of user data. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_best_effort_allocate

Best effort to allocate space for a file

Prototype

```
UINT fx_file_extended best_effort_allocate(FX_FILE *file_ptr, ULONG64 size,
                                           ULONG64 *actual_size_allocated)
```

Description

This service allocates and links one or more contiguous clusters to the end of the specified file. FileX determines the number of clusters required by dividing the requested size by the number of bytes per cluster. The result is then rounded up to the next whole cluster. If there are not enough consecutive clusters available in the media, this service links the largest available block of consecutive clusters to the file. The amount of space actually allocated to the file is returned to the caller.

This service is designed for exFAT. The *size* parameter takes a 64-bit integer value, which allows the caller to pre-allocate space beyond 4GB range.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	Number of bytes to allocate for the file.

Return Values

FX_SUCCESS	(0x00)	Successful best-effort file allocation.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
TX_NO_MORE_SPACE	(0x0A)	Media associated with this file does not have enough available clusters.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.

FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer or destination.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;
ULONG64          actual_allocation;

/* Attempt to allocate 0x100000000 bytes to the end
   of my_file. */
status =  fx_file_extended_best_effort_allocate(&my_file,
                 0x100000000, &actual_allocation);

/* If status equals FX_SUCCESS, the number of bytes
   allocated to the file is found in actual_allocation. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_relative_seek

Positions to a relative byte offset

Prototype

```
UINT fx_file_extended_relative_seek(FX_FILE *file_ptr, ULONG64 byte_offset,
                                    UINT seek_from)
```

Description

This service positions the internal file read/write pointer to the specified relative byte offset. Any subsequent file read or write request will begin at this location in the file.

This service is designed for exFAT. The *byte_offset* parameter takes a 64-bit integer value, which allows the caller to reposition the read/write pointer beyond 4GB range.

If the seek operation attempts to seek past the end of the file, the file's read/write pointer is positioned to the end of the file. Conversely, if the seek operation attempts to position past the beginning of the file, the file's read/write pointer is positioned to the beginning of the file.

Input Parameters

file_ptr Pointer to a previously opened file.

byte_offset Desired relative byte offset in file.

seek_from The direction and location of where to perform the relative seek from. Valid seek options are defined as follows:

FX_SEEK_BEGIN	(0x00)
FX_SEEK_END	(0x01)
FX_SEEK_FORWARD	(0x02)
FX_SEEK_BACK	(0x03)

If ***FX_SEEK_BEGIN*** is specified, the seek operation is performed from the beginning of the file. If ***FX_SEEK_END*** is specified the seek operation is performed backward from the end of the file. If ***FX_SEEK_FORWARD*** is specified, the seek operation is performed forward from the current file position. If ***FX_SEEK_BACK*** is specified, the seek operation is performed backward from the current file position.

Return Values

FX_SUCCESS	(0x00)	Successful file relative seek.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE         my_file;
UINT            status;

/* Attempt to seek forward 0x100000000 bytes in "my_file". */
status =  fx_file_extended_relative_seek(&my_file, 0x100000000,
                                FX_SEEK_FORWARD);

/* If status equals FX_SUCCESS, the file read/write
   pointers are positioned 0x100000000 bytes forward. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_seek

Positions to byte offset

Prototype

```
UINT fx_file_extended_seek(FX_FILE *file_ptr, ULONG64 byte_offset)
```

Description

This service positions the internal file read/write pointer to the specified byte offset. Any subsequent file read or write request will begin at this location in the file.

This service is designed for exFAT. The *byte_offset* parameter takes a 64-bit integer value, which allows the caller to reposition the read/write pointer beyond 4GB range.

Input Parameters

file_ptr	Pointer to the file control block.
byte_offset	Desired byte offset in file. A value of zero will position the read/write pointer at the beginning of the file, while a value greater than the file's size will position the read/write pointer at the end of the file.

Return Values

FX_SUCCESS	(0x00)	Successful file seek.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILEmy_file;
UINTstatus;

/* Seek to position 0x100000000 of "my_file." */
status = fx_file_extended_seek(&my_file, 0x100000000);

/* If status equals FX_SUCCESS, the file read/write pointer is now
positioned 0x100000000 bytes from the beginning of the file. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_truncate

Truncates file

Prototype

```
UINT fx_file_truncate(FX_FILE *file_ptr, ULONG64 size)
```

Description

This service truncates the size of the file to the specified size. If the supplied size is greater than the actual file size, this service doesn't do anything. None of the media clusters associated with the file are released.

Use caution truncating files that may also be simultaneously open for reading. Truncating a file also opened for reading can result in reading invalid data.

This service is designed for exFAT. The *size* parameter takes a 64-bit integer value, which allows the caller to operate beyond 4GB range.

Input Parameters

file_ptr	Pointer to the file control block.
size	New file size. Bytes past this new file size are discarded.

Return Values

FX_SUCCESS	(0x00)	Successful file truncate.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.

FX_WRITE_PROTECT	(0x23)	Underlying media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;


/* Truncate "my_file" to 0x100000000 bytes. */
status = fx_file_extended_truncate(&my_file, 0x100000000);

/* If status equals FX_SUCCESS, "my_file" contains 0x100000000
   or fewer bytes. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_extended_truncate_release

Truncates file and releases cluster(s)

Prototype

```
UINT fx_file_extended_truncate_release(FX_FILE *file_ptr, ULONG64 size)
```

Description

This service truncates the size of the file to the specified size. If the supplied size is greater than the actual file size, this service does not do anything. Unlike the ***fx_file_extended_truncate*** service, this service does release any unused clusters.

Use caution truncating files that may also be simultaneously open for reading. Truncating a file also opened for reading can result in reading invalid data.

This service is designed for exFAT. The *size* parameter takes a 64-bit integer value, which allows the caller to operate beyond 4GB range.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	New file size. Bytes past this new file size are discarded.

Return Values

FX_SUCCESS	(0x00)	Successful file truncate.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;

/* Attempt to truncate everything after the
   first 0x100000000 bytes of "my_file". */
status =  fx_file_extended_truncate_release(&my_file, 0x100000000);

/* If status equals FX_SUCCESS, the file is
   now 0x100000000 bytes or fewer and all unused clusters
   have been released. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_open

Opens file

Prototype

```
UINT fx_file_open(FX_MEDIA *media_ptr, FX_FILE *file_ptr,
                  CHAR *file_name, UINT open_type)
```

Description

This service opens the specified file for either reading or writing. A file may be opened for reading multiple times, while a file can only be opened for writing once until the writer closes the file.

i *Care must be taken if a file is concurrently open for reading and writing. File writing performed when a file is simultaneously opened for reading may not be seen by the reader, unless the reader closes and reopens the file for reading. Similarly, the file writer should be careful when using file truncate services. If a file is truncated by the writer, readers of the same file could return invalid data.*

Input Parameters

media_ptr	Pointer to a media control block.
file_ptr	Pointer to the file control block.
file_name	Pointer to the name of the file to open (directory path is optional).
open_type	Type of file open. Valid open type options are: **FX_OPEN_FOR_READ** (0x00) **FX_OPEN_FOR_WRITE** (0x01) **FX_OPEN_FOR_READ_FAST** (0x02) Opening files with ***FX_OPEN_FOR_READ*** and ***FX_OPEN_FOR_READ_FAST*** is similar: ***FX_OPEN_FOR_READ*** includes verification that the linked-list of clusters that comprise the file are intact, and ***FX_OPEN_FOR_READ_FAST***

does not perform this verification, which makes it faster.

Return Values

FX_SUCCESS	(0x00)	Successful file open.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Specified file was not found.
FX_NOT_A_FILE	(0x05)	Specified file name was a directory or volume.
FX_FILE_CORRUPT	(0x08)	Specified file is corrupt and the open failed.
FX_ACCESS_ERROR	(0x06)	Specified file is already open or open type is invalid.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_MEDIA_INVALID	(0x02)	Invalid media.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Underlying media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
FX_FILE         my_file;
UINT            status;

/* Open the file "myfile.txt" for reading. */
status = fx_file_open(&my_media, &my_file, "myfile.txt",
                          FX_OPEN_FOR_READ);

/* If status equals FX_SUCCESS, file "myfile.txt" is now open
   and may be accessed now with the my_file pointer. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_read

Reads bytes from file

Prototype

```
UINT fx_file_read(FX_FILE *file_ptr, VOID *buffer_ptr, ULONG request_size,
                  ULONG *actual_size)
```

Description

This service reads bytes from the file and stores them in the supplied buffer. After the read is complete, the file's internal read pointer is adjusted to point at the next byte in the file. If there are fewer bytes remaining in the request, only the bytes remaining are stored in the buffer. In any case, the total number of bytes placed in the buffer is returned to the caller.

The application must ensure that the buffer supplied is able to store the specified number of requested bytes.

*Faster performance is achieved if the destination buffer is on a long-word boundary and the requested size is evenly divisible by sizeof(**ULONG**).*

Input Parameters

file_ptr	Pointer to the file control block.
buffer_ptr	Pointer to the destination buffer for the read.
request_size	Maximum number of bytes to read.
actual_size	Pointer to the variable to hold the actual number of bytes read into the supplied buffer.

Return Values

FX_SUCCESS	(0x00)	Successful file read.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_FILE_CORRUPT	(0x08)	Specified file is corrupt and the read failed.
FX_END_OF_FILE	(0x09)	End of file has been reached.

FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid file or buffer pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
unsigned char    my_buffer[1024];
ULONG            actual_bytes;
UINT             status;

/* Read up to 1024 bytes into "my_buffer." */
status = fx_file_read(&my_file, my_buffer, 1024,
                             &actual_bytes);

/* If status equals FX_SUCCESS, "my_buffer" contains
   the bytes read from the file. The total number of bytes
   read is in "actual_bytes." */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_relative_seek

Positions to a relative byte offset

Prototype

```
UINT fx_file_relative_seek(FX_FILE *file_ptr, ULONG byte_offset,
                           UINT seek_from)
```

Description

This service positions the internal file read/write pointer to the specified relative byte offset. Any subsequent file read or write request will begin at this location in the file.

If the seek operation attempts to seek past the end of the file, the file's read/write pointer is positioned to the end of the file. Conversely, if the seek operation attempts to position past the beginning of the file, the file's read/write pointer is positioned to the beginning of the file.

To seek with an offset value beyond 4GB, application shall use the service *fx_file_extended_relative_seek*.

Input Parameters

file_ptr Pointer to a previously opened file.

byte_offset Desired relative byte offset in file.

seek_from The direction and location of where to perform the relative seek from. Valid seek options are defined as follows:

FX_SEEK_BEGIN	(0x00)
FX_SEEK_END	(0x01)
FX_SEEK_FORWARD	(0x02)
FX_SEEK_BACK	(0x03)

If ***FX_SEEK_BEGIN*** is specified, the seek operation is performed from the beginning of the file. If ***FX_SEEK_END*** is specified the seek operation is performed backward from the end of the file. If ***FX_SEEK_FORWARD*** is specified, the seek operation is performed forward from the current file position. If ***FX_SEEK_BACK*** is specified, the seek operation is performed backward from the current file position.

Return Values

FX_SUCCESS	(0x00)	Successful file relative seek.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE         my_file;
UINT            status;

/* Attempt to move 10 bytes forward in "my_file". */
status =  fx_file_relative_seek(&my_file, 10,
                FX_SEEK_FORWARD);

/* If status equals FX_SUCCESS, the file read/write
   pointers are positioned 10 bytes forward. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_rename

Renames file

Prototype

```
UINT fx_file_rename(FX_MEDIA *media_ptr, CHAR *old_file_name,
                    CHAR *new_file_name)
```

Description

This service changes the name of the file specified by *old_file_name*. Renaming is also done relative to the specified path or the default path. If a path is specified in the new file name, the renamed file is effectively moved to the specified path. If no path is specified, the renamed file is placed in the current default path.

Input Parameters

media_ptr	Pointer to a media control block.
old_file_name	Pointer to the name of the file to rename (directory path is optional).
new_file_name	Pointer to the new file name. The directory path is not allowed.

Return Values

FX_SUCCESS	(0x00)	Successful file rename.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Specified file was not found.
FX_NOT_A_FILE	(0x05)	Specified file is a directory.
FX_ACCESS_ERROR	(0x06)	Specified file is already open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_INVALID_NAME	(0x0C)	Specified new file name is not a valid file name.
FX_INVALID_PATH	(0x0D)	Path is invalid.
FX_ALREADY_CREATED	(0x0B)	The new file name is used.

FX_MEDIA_INVALID	(0x02)	Media is invalid.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT table.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;
UINT             status;
/* Rename "myfile1.txt" to "myfile2.txt" in the default
   directory of the media. */
status = fx_file_rename(&my_media, "myfile1.txt",
                          "myfile2.txt");

/* If status equals FX_SUCCESS, the file was successfully
   renamed. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_seek

Positions to byte offset

Prototype

```
UINT fx_file_seek(FX_FILE *file_ptr, ULONG byte_offset)
```

Description

This service positions the internal file read/write pointer to the specified byte offset. Any subsequent file read or write request will begin at this location in the file.

To seek with an offset value beyond 4GB, application shall use the service *fx_file_extended_seek*.

Input Parameters

file_ptr	Pointer to the file control block.
byte_offset	Desired byte offset in file. A value of zero will position the read/write pointer at the beginning of the file, while a value greater than the file's size will position the read/write pointer at the end of the file.

Return Values

FX_SUCCESS	(0x00)	Successful file seek.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE         my_file;
UINT            status;

/* Seek to the beginning of "my_file." */
status = fx_file_seek(&my_file, 0);

/* If status equals FX_SUCCESS, the file read/write pointer
   is now positioned to the beginning of the file. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_truncate

Truncates file

Prototype

```
UINT fx_file_truncate(FX_FILE *file_ptr, ULONG size)
```

Description

This service truncates the size of the file to the specified size. If the supplied size is greater than the actual file size, this service doesn't do anything. None of the media clusters associated with the file are released.

Use caution truncating files that may also be simultaneously open for reading. Truncating a file also opened for reading can result in reading invalid data.

To operate beyond 4GB, application shall use the service *fx_file_extended_truncate*.

Input Parameters

file_ptr	Pointer to the file control block.
size	New file size. Bytes past this new file size are discarded.

Return Values

FX_SUCCESS	(0x00)	Successful file truncate.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.

FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;


/* Truncate "my_file" to 100 bytes. */
status = fx_file_truncate(&my_file, 100);

/* If status equals FX_SUCCESS, "my_file" contains 100
   or fewer bytes. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_truncate_release

Truncates file and releases cluster(s)

Prototype

```
UINT fx_file_truncate_release(FX_FILE *file_ptr, ULONG size)
```

Description

This service truncates the size of the file to the specified size. If the supplied size is greater than the actual file size, this service does not do anything. Unlike the ***fx_file_truncate*** service, this service does release any unused clusters.

! *Use caution truncating files that may also be simultaneously open for reading. Truncating a file also opened for reading can result in reading invalid data.*

To operate beyond 4GB, application shall use the service *fx_file_extended_truncate_release*.

Input Parameters

file_ptr	Pointer to a previously opened file.
size	New file size. Bytes past this new file size are discarded.

Return Values

FX_SUCCESS	(0x00)	Successful file truncate.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NOT_OPEN	(0x07)	Specified file is not currently open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Underlying media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_NO_MORE_SPACE	(0x0A)	No more space to complete the operation.
FX_PTR_ERROR	(0x18)	Invalid file pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE         my_file;
UINT            status;

/* Attempt to truncate everything after the
   first 100 bytes of "my_file". */
status =  fx_file_truncate_release(&my_file, 100);

/* If status equals FX_SUCCESS, the file is
   now 100 bytes or fewer and all unused clusters
   have been released. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_write

Writes bytes to file

Prototype

```
UINT fx_file_write(FX_FILE *file_ptr, VOID *buffer_ptr, ULONG size)
```

Description

This service writes bytes from the specified buffer starting at the file's current position. After the write is complete, the file's internal read pointer is adjusted to point at the next byte in the file.

*Faster performance is achieved if the source buffer is on a long-word boundary and the requested size is evenly divisible by sizeof(**ULONG**).*

Input Parameters

file_ptr	Pointer to the file control block.
buffer_ptr	Pointer to the source buffer for the write.
size	Number of bytes to write.

Return Values

FX_SUCCESS	(0x00)	Successful file write.
FX_NOT_OPEN	(0x07)	Specified file is not open.
FX_ACCESS_ERROR	(0x06)	Specified file is not open for writing.
FX_NO_MORE_SPACE	(0x0A)	There is no more room available in the media to perform this write.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT entry.

FX_NO_MORE_ENTRIES	(0x0F)	No more FAT entries.
FX_PTR_ERROR	(0x18)	Invalid file or buffer pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_FILE          my_file;
UINT             status;


/* Write a 10 character buffer to "my_file." */
status = fx_file_write(&my_file, "1234567890", 10);

/* If status equals FX_SUCCESS, the small text string
   was written out to the file. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_file_write_notify_set

Sets the file write notify function

Prototype

```
UINT fx_file_write_notify_set(FX_FILE *file_ptr,
                              VOID (*file_write_notify)(FX_FILE*))
```

Description

This service installs callback function that is invoked after a successful file write operation.

Input Parameters

file_ptr	Pointer to the file control block.
file_write_notify	File write callback function to be installed. Set the callback function to NULL disables the callback function.

Return Values

FX_SUCCESS	(0x00)	Successfully installed the callback function.
FX_PTR_ERROR	(0x18)	file_ptr is NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
fx_file_write_notify_set(file_ptr, my_file_close_callback);
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_media_abort

Aborts media activities

Prototype

```
UINT fx_media_abort(FX_MEDIA *media_ptr)
```

Description

This service aborts all current activities associated with the media, including closing all open files, sending an abort request to the associated driver, and placing the media in an aborted state. This service is typically called when I/O errors are detected.

The media must be re-opened to use it again after an abort operation is performed.

Input Parameters

media_ptr	Pointer to media control block.

Return Values

FX_SUCCESS	(0x00)	Successful media abort.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;


/* Abort all activity associated with "my_media". */
status = fx_media_abort(&my_media);

/* If status equals FX_SUCCESS, all activity associated
   with the media has been aborted. */
```

See Also

fx_fault_tolerant_enable, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_cache_invalidate

Invalidates logical sector cache

Prototype

```
UINT  fx_media_cache_invalidate(FX_MEDIA *media_ptr)
```

Description

This service flushes all dirty sectors in the cache and then invalidates the entire logical sector cache.

Input Parameters

media_ptr	Pointer to media control block

Return Values

FX_SUCCESS	(0x00)	Successful media cache invalidate.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media or scratch pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;

/* Invalidate the cache of the media. */
status =  fx_media_cache_invalidate(&my_media);

/* If status is FX_SUCCESS the cache in the media was successfully
   flushed and invalidated.  */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_check

Checks media for errors

Prototype

```
UINT  fx_media_check(FX_MEDIA *media_ptr,
                     UCHAR *scratch_memory_ptr,
                     ULONG scratch_memory_size,
                     ULONG error_correction_option,
                     ULONG *errors_detected_ptr)
```

Description

This service checks the specified media for basic structural errors, including file/directory cross-linking, invalid FAT chains, and lost clusters. This service also provides the capability to correct detected errors.

The fx_media_check service requires scratch memory for its depth-first analysis of directories and files in the media. Specifically, the scratch memory supplied to the media check service must be large enough to hold several directory entries, a data structure to “stack” the current directory entry position before entering into subdirectories, and finally the logical FAT bit map. The scratch memory should be at least 512-1024 bytes plus memory for the logical FAT bit map, which requires as many bits as there are clusters in the media. For example, a device with 8000 clusters would require 1000 bytes to represent and thus require a total scratch area on the order of 2048 bytes.

This service should only be called immediately after fx_media_open and without any other file system activity.

Input Parameters

media_ptr Pointer to media control block.

scratch_memory_ptr Pointer to the start of scratch memory.

scratch_memory_size Size of scratch memory in bytes.

error_correction_option Error correction option bits, when the bit is set, error correction is performed. The error correction option bits are defined as follows:

	FX_FAT_CHAIN_ERROR (0x01)
	FX_DIRECTORY_ERROR (0x02)
	FX_LOST_CLUSTER_ERROR(0x04)
	Simply OR together the required error correction options. If no error correction is required, a value of 0 should be supplied.
errors_detected_ptr	Destination for error detection bits, as defined below:
	FX_FAT_CHAIN_ERROR (0x01)
	FX_DIRECTORY_ERROR (0x02) **FX_LOST_CLUSTER_ERROR**(0x04) **FX_FILE_SIZE_ERROR** (0x08)

Return Values

FX_SUCCESS	(0x00)	Successful media check, view the errors detected destination for details.
FX_ACCESS_ERROR	(0x06)	Unable to perform check with open files.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NO_MORE_SPACE	(0x0A)	No more space on the media.
FX_NOT_ENOUGH_MEMORY	(0x91)	Supplied scratch memory is not large enough.
FX_ERROR_NOT_FIXED	(0x93)	Corruption of FAT32 root directory that could not be fixed.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_SECTOR_INVALID	(0x89)	Sector is invalid.
FX_PTR_ERROR	(0x18)	Invalid media or scratch pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAmy_media;
ULONG           detected_errors;
UCHAR           sratch_memory[4096];

/* Check the media and correct all errors. */
status =  fx_media_check(&my_media, sratch_memory, 4096,
   FX_FAT_CHAIN_ERROR | FX_DIRECTORY_ERROR |
   FX_LOST_CLUSTER_ERROR, &detected_errors);

/* If status is FX_SUCCESS and detected_errors is 0, the media was
   successfully checked and found to be error free.  */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_close

Closes media

Prototype

```
UINT fx_media_close(FX_MEDIA *media_ptr)
```

Description

This service closes the specified media. In the process of closing the media, all open files are closed and any remaining buffers are flushed to the physical media.

Input Parameters

media_ptr	Pointer to media control block.

Return Values

FX_SUCCESS	(0x00)	Successful media close.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Close "my_media". */
status = fx_media_close(&my_media);

/* If status equals FX_SUCCESS, "my_media" is closed. */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_close_notify_set

Sets the media close notify function

Set Media Close Notify Function

Prototype

```
UINT fx_media_close_notify_set(FX_MEDIA *media_ptr,
                               VOID (*media_close_notify)(FX_MEDIA*))
```

Description

This service sets a notify callback function which will be invoked after a media is successfully closed.

Input Parameters

media_ptr	Pointer to media control block.
media_close_notify	Media close notify callback function to be installed. Passing NULL as the callback function disables the media close callback.

Return Values

FX_SUCCESS	(0x00)	Successfully installed the callback function.
FX_PTR_ERROR	(0x18)	media_ptr is NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
fx_media_close_notify_set(media_ptr, my_media_close_callback);
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_exFAT_format

Formats media

Prototype

```
UINT  fx_media_exFAT_format(FX_MEDIA *media_ptr,
                            VOID (*driver)(FX_MEDIA *media),
                            VOID *driver_info_ptr, UCHAR *memory_ptr,
                            UINT memory_size, CHAR *volume_name,
                            UINT number_of_fats, ULONG64 hidden_sectors,
                            ULONG64 total_sectors, UINT bytes_per_sector,
                            UINT sectors_per_cluster,
                            UINT volume_serial_number,
                            UINT boundary_unit)
```

Description

This service formats the supplied media in an exFAT compatible manner based on the supplied parameters. This service must be called prior to opening the media.

Formatting an already formatted media effectively erases all files and directories on the media.

Input Parameters

media_ptr Pointer to media control block. This is used only to provide some basic information necessary for the driver to operate.

driver Pointer to the I/O driver for this media. This will typically be the same driver supplied to the subsequent fx_media_open call.

driver_info_ptr Pointer to optional information that the I/O driver may utilize.

memory_ptr Pointer to the working memory for the media.

memory_size Specifies the size of the working media memory. The size must be at least as large as the media's sector size.

volume_name	Pointer to the volume name string, which is a maximum of 11 characters.
number_of_fats	Number of FATs on the media. Current implementation supports one FAT on the media.
hidden_sectors	Number of sectors hidden before this media's boot sector. This is typical when multiple partitions are present.
total_sectors	Total number of sectors in the media.
bytes_per_sector	Number of bytes per sector, which is typically 512. FileX requires this to be a multiple of 32.
sectors_per_cluster	Number of sectors in each cluster. The cluster is the minimum allocation unit in a FAT file system.
volumne_serial_number	Serial number to be used for this volume.
boundary_unit	Physical data area alignment size, in number of sectors.

Return Values

FX_SUCCESS	(0x00)	Successful media format.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media, driver, or memory pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAsd_card;
UCHAR            media_memory[512];

/* Format a 64GB SD card with exFAT file system.  The media has been
   properly partitioned, with the partition starts from sector
   32768.  For 64GB, there are total of 120913920 sectors, each
   sector 512 bytes. */

   status =  fx_media_exFAT_format(&sd_card,
                 _fx_sd_driver, driver_information,
                 media_memory, sizeof(media_memory),
                 "exFAT_DISK" /* Volume Name  */,
                 1         /* Number of FATs  */,
                 32768     /* Hidden sectors  */,
                 120913920 /* Total sectors  */,
                 512       /* Sector size  */,
                 256       /* Sectors per cluster  */,
                 12345     /* Volume ID  */,
                 8192      /* Boundary unit  */);

/* If status is FX_SUCCESS, the media was successfully formatted. */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_extended_space_available

Returns available media space

Prototype

```
UINT fx_media_extended_space_available(FX_MEDIA *media_ptr,
                                       ULONG64 *available_bytes_ptr)
```

Description

This service returns the number of bytes available in the media.

This service is designed for exFAT. The pointer to *available_bytes* parameter takes a 64-bit integer value, which allows the caller to work with media beyond 4GB range.

Input Parameters

media_ptr	Pointer to a previously opened media.
available_bytes_ptr	Available bytes left in the media.

Return Values

FX_SUCCESS	(0x00)	Successfully retrieved space available on the media.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_PTR_ERROR	(0x18)	Invalid media pointer or available bytes pointer is NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA                  my_media;
ULONG64          available_bytes;
UINT             status;

/* Retrieve the available bytes in the media. */
status = fx_media_extended_space_available(&my_media,
                          &available_bytes);

/* If status equals FX_SUCCESS, the number of available
   bytes is in "available_bytes." */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_flush

Flushes data to physical media

Prototype

```
UINT fx_media_flush(FX_MEDIA *media_ptr)
```

Description

This service flushes all cached sectors and directory entries of any modified files to the physical media.

This routine may be called periodically by the application to reduce the risk of file corruption and/or data loss in the event of a sudden loss of power on the target.

Input Parameters

media_ptr	Pointer to media control block.

Return Values

FX_SUCCESS	(0x00)	Successful media flush.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_FILE_CORRUPT	(0x08)	File is corrupted.
FX_SECTOR_INVALID	(0x89(	Invalid sector.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UINT            status;

/* Flush all cached sectors and modified file entries to
   the physical media. */
status = fx_media_flush(&my_media);

/* If status equals FX_SUCCESS, the physical media is
   completely up-to-date. */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_format

Formats media

Prototype

```
UINT  fx_media_format(FX_MEDIA *media_ptr,
                      VOID (*driver)(FX_MEDIA *media),
                      VOID *driver_info_ptr,
                      UCHAR *memory_ptr, UINT memory_size,
                      CHAR *volume_name, UINT number_of_fats,
                      UINT directory_entries, UINT hidden_sectors,
                      ULONG total_sectors, UINT bytes_per_sector,
                      UINT sectors_per_cluster,
                      UINT heads, UINT sectors_per_track)
```

Description

This service formats the supplied media in a FAT 12/16/32 compatible manner based on the supplied parameters. This service must be called prior to opening the media.

Formatting an already formatted media effectively erases all files and directories on the media.

Input Parameters

media_ptr	Pointer to media control block. This is used only to provide some basic information necessary for the driver to operate.
driver	Pointer to the I/O driver for this media. This will typically be the same driver supplied to the subsequent fx_media_open call.
driver_info_ptr	Pointer to optional information that the I/O driver may utilize.
memory_ptr	Pointer to the working memory for the media.
memory_size	Specifies the size of the working media memory. The size must be at least as large as the media's sector size.
volume_name	Pointer to the volume name string, which is a maximum of 11 characters.

number_of_fats	Number of FATs in the media. The minimal value is 1 for the primary FAT. Values greater than 1 result in additional FAT copies being maintained at run-time.
directory_entries	Number of directory entries in the root directory.
hidden_sectors	Number of sectors hidden before this media's boot sector. This is typical when multiple partitions are present.
total_sectors	Total number of sectors in the media.
bytes_per_sector	Number of bytes per sector, which is typically 512. FileX requires this to be a multiple of 32.
sectors_per_cluster	Number of sectors in each cluster. The cluster is the minimum allocation unit in a FAT file system.
heads	Number of physical heads.
sectors_per_track	Number of sectors per track.

Return Values

FX_SUCCESS	(0x00)	Successful media format.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media, driver, or memory pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIAram_disk;
UCHAR           media_memory[512];
UCHAR           ram_disk_memory[32768];

/* Format a RAM disk with 32768 bytes and 512 bytes per sector. */
status =  fx_media_format(&ram_disk,
                _fx_ram_driver, ram_disk_memory,
                media_memory, sizeof(media_memory),
                "MY_RAM_DISK" /* Volume Name  */,
                1         /* Number of FATs  */,
                32        /* Directory Entries  */,
                0         /* Hidden sectors  */,
                64        /* Total sectors  */,
                512       /* Sector size  */,
                1         /* Sectors per cluster  */,
                1         /* Heads  */,
                1         /* Sectors per track  */);

/* If status is FX_SUCCESS, the media was successfully formatted
   and can now be opened with the following call:  */
fx_media_open(&ram_disk, _fx_ram_driver, ram_disk_memory,
                media_memory, sizeof(media_memory);
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_open

Opens media for file access

Prototype

```
UINT fx_media_open(FX_MEDIA *media_ptr, CHAR *media_name,
                   VOID(*media_driver)(FX_MEDIA *), VOID *driver_info_ptr,
                   VOID *memory_ptr, ULONG memory_size)
```

Description

This service opens a media for file access using the supplied I/O driver.

The memory supplied to this service is used to implement an internal logical sector cache, hence, the more memory supplied the more physical I/O is reduced. FileX requires a cache of at least one logical sector (bytes per sector of the media).

Input Parameters

media_ptr	Pointer to media control block.
media_name	Pointer to media's name.
media_driver	Pointer to I/O driver for this media. The I/O driver must conform to FileX driver requirements defined in Chapter 5.
driver_info_ptr	Pointer to optional information that the supplied I/O driver may utilize.
memory_ptr	Pointer to the working memory for the media.
memory_size	Specifies the size of the working media memory. The size must be as large as the media's sector size (typically 512 bytes).

Return Values

FX_SUCCESS	(0x00)	Successful media open.
FX_BOOT_ERROR	(0x01)	Error reading the media's boot sector.
FX_MEDIA_INVALID	(0x02)	Specified media's boot sector is corrupt or invalid. In addition, this return code is used to indicate that either the logical sector cache size or the FAT entry size is not a power of 2.
FX_FAT_READ_ERROR	(0x03)	Error reading the media FAT.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	One or more pointers are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA       ram_disk,
UINT           status;
UCHAR          buffer[128];

/* Open a 32KByte RAM disk starting at the fixed address of
   0x800000. Note that the total 32KByte media size and
   128-byte sector size is defined inside of the driver. */
status =  fx_media_open(&ram_disk, "RAM DISK", fx_ram_driver,
                        0, &buffer[0], sizeof(buffer));

/* If status equals FX_SUCCESS, the RAM disk has been
   successfully setup and is ready for file access! */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_open_notify_set

Sets the media open notify function

Prototype

```
UINT fx_media_open_notify_set(FX_MEDIA *media_ptr,
                              VOID (*media_open_notify)(FX_MEDIA*))
```

Description

This service sets a notify callback function which will be invoked after a media is successfully opened.

Input Parameters

media_ptr	Pointer to media control block.
media_open_notify	Media open notify callback function to be installed. Passing NULL as the callback function disables the media open callback.

Return Values

FX_SUCCESS	(0x00)	Successfuly installed the callback function.
FX_PTR_ERROR	(0x18)	media_ptr is NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
fx_media_open_notify_set(media_ptr, my_media_open_callback);
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_read

Reads logical sector from media

Prototype

```
UINT fx_media_read(FX_MEDIA *media_ptr,
                             ULONG logical_sector, VOID *buffer_ptr)
```

Description

This service reads a logical sector from the media and places it into the supplied buffer.

Input Parameters

media_ptr	Pointer to a previously opened media.
logical_sector	Logical sector to read.
buffer_ptr	Pointer to the destination for the logical sector read.

Return Values

FX_SUCCESS	(0x00)	Successful media read.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_SECTOR_INVALID	(0x89)	Invalid Sector.
FX_PTR_ERROR	(0x18)	Invalid media or buffer pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA         my_media;
UCHAR            my_buffer[128];
UINT             status;

/* Read logical sector 22 into "my_buffer" assuming the
   physical media has a sector size of 128. */
status = fx_media_read(&my_media, 22, my_buffer);

/* If status equals FX_SUCCESS, the contents of logical
   sector 22 are in "my_buffer." */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_space_available

Returns available media space

Prototype

```
UINT fx_media_space_available(FX_MEDIA *media_ptr,
                              ULONG *available_bytes_ptr)
```

Description

This service returns the number of bytes available in the media.

To work with the media larger than 4GB, application shall use the service *fx_media_extended_space_available*.

Input Parameters

media_ptr	Pointer to a previously opened media.
available_bytes_ptr	Available bytes left in the media.

Return Values

FX_SUCCESS	(0x00)	Successfully returned available space on media.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_PTR_ERROR	(0x18)	Invalid media pointer or available bytes pointer is NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA                    my_media;
ULONG           available_bytes;
UINT            status;

/* Retrieve the available bytes in the media. */
status = fx_media_space_available(&my_media,
                            &available_bytes);

/* If status equals FX_SUCCESS, the number of available
   bytes is in "available_bytes." */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_volume_get, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_volume_get

Gets media volume name

Prototype

```
UINT  fx_media_volume_get(FX_MEDIA *media_ptr, CHAR *volume_name,
                          UINT volume_source)
```

Description

This service retrieves the volume name of the previously opened media.

Input Parameters

media_ptr	Pointer to media control block.
volume_name	Pointer to destination for volume name. Note that the destination must be at least large enough to hold 12 characters.
volume_source	Designates where to retrieve the name, either from the boot sector or the root directory. Valid values for this parameter are: **FX_BOOT_SECTOR** **FX_DIRECTORY_SECTOR**

Return Values

FX_SUCCESS	(0x00)	Successful media volume get.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Volume not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media or volume destination pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA          ram_disk;
UCHAR             volume_name[12];
/* Retrieve the volume name of the RAM disk, from the boot sector.
*/
status =  fx_media_volume_get_extended(&ram_disk, volume_name,
                  sizeof(volume_name)
                  FX_BOOT_SECTOR);
/* If status is FX_SUCCESS, the volume name was successfully
   retrieved.  */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_volume_get_extended

Gets media volume name of previously opened media

Prototype

```
UINT  fx_media_volume_get_extended(FX_MEDIA *media_ptr,
                                   CHAR *volume_name,
                                   UINT volume_name_buffer_length,
                                   UINT volume_source)
```

Description

This service retrieves the volume name of the previously opened media.

This service is identical to ***fx_media_volume_get()*** except the caller passes in the size of the **volume_name** buffer.

Input Parameters

media_ptr Pointer to media control block.

volume_name Pointer to destination for volume name. Note that the destination must be at least large enough to hold 12 characters.

volume_name_buffer_length

Size of volume_name buffer.

volume_source Designates where to retrieve the name, either from the boot sector or the root directory. Valid values for this parameter are:

FX_BOOT_SECTOR

FX_DIRECTORY_SECTOR

Return Values

FX_SUCCESS	(0x00)	Successful media volume get.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Volume not found.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	Invalid media or volume destination pointer.

FX_CALLER_ERROR (0x20) Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA          ram_disk;
UCHAR             volume_name[12];
/* Retrieve the volume name of the RAM disk, from the boot sector.
*/
status =  fx_media_volume_get_extended(&ram_disk, volume_name,
                          sizeof(volume_name)
                          FX_BOOT_SECTOR);
/* If status is FX_SUCCESS, the volume name was successfully
   retrieved.  */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_set, fx_media_write, fx_system_initialize

fx_media_volume_set

Sets media volume name

Prototype

```
UINT  fx_media_volume_set(FX_MEDIA *media_ptr, CHAR *volume_name)
```

Description

This service sets the volume name of the previously opened media.

Input Parameters

media_ptr	Pointer to media control block.
volume_name	Pointer to the volume name.

Return Values

FX_SUCCESS	(0x00)	Successful media volume set.
FX_INVALID_NAME	(0x0C)	Volume_name is invalid.
FX_MEDIA_INVALID	(0x02)	Unable to set volume name.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or volume name pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        ram_disk;

/* Set the volume name to "MY_VOLUME". */
status =  fx_media_volume_set(&ram_disk, "MY_VOLUME");

/* If status is FX_SUCCESS, the volume name was successfully
   set.  */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_write, fx_system_initialize

fx_media_write

Writes logical sector

Prototype

```
UINT fx_media_write(FX_MEDIA *media_ptr, ULONG logical_sector,
                    VOID *buffer_ptr)
```

Description

This service writes the supplied buffer to the specified logical sector.

Input Parameters

media_ptr	Pointer to a previously opened media.
logical_sector	Logical sector to write.
buffer_ptr	Pointer to the source for the logical sector write.

Return Values

FX_SUCCESS	(0x00)	Successful media write.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media pointer.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        my_media;
UCHAR           my_buffer[128];
UINT            status;

/* Write logical sector 22 from "my_buffer" assuming the
   physical media has a sector size of 128. */
status = fx_media_write(&my_media, 22, my_buffer);

/* If status equals FX_SUCCESS, the contents of logical
   sector 22 are now the same as "my_buffer." */
```

See Also

fx_fault_tolerant_enable, fx_media_abort, fx_media_cache_invalidate, fx_media_check, fx_media_close, fx_media_close_notify_set, fx_media_exFAT_format, fx_media_extended_space_available, fx_media_flush, fx_media_format, fx_media_open, fx_media_open_notify_set, fx_media_read, fx_media_space_available, fx_media_volume_get, fx_media_volume_set, fx_system_initialize

fx_system_date_get

Gets file system date

Prototype

```
UINT fx_system_date_get(UINT *year, UINT *month, UINT *day)
```

Description

This service returns the current system date.

Input Parameters

year	Pointer to destination for year.
month	Pointer to destination for month.
day	Pointer to destination for day.

Return Values

FX_SUCCESS	(0x00)	Successful date retrieval.
FX_PTR_ERROR	(0x18)	One or more of the input parameters are NULL.

Allowed From

Threads

Example

```
UINT            status;
UINT            year;
UINT            month;
UINT            day;
/* Retrieve the current system date. */
status = fx_system_date_get(&year, &month, &day);

/* If status equals FX_SUCCESS, the year, month, and day
   parameters now have meaningful information. */
```

See Also

fx_system_date_set, fx_system_initialize, fx_system_time_get, fx_system_time_set

fx_system_date_set

Sets system date

Prototype

```
UINT fx_system_date_set(UINT year, UINT month, UINT day)
```

Description

This service sets the system date as specified.

*This service should be called shortly after **fx_system_initialize** to set the initial system date. By default, the system date is that of the last generic FileX release.*

Input Parameters

year	New year. The valid range is from 1980 through the year 2107.
month	New month. The valid range is from 1 through 12.
day	New day. The valid range is from 1 through 31, depending on month and leap year conditions.

Return Values

FX_SUCCESS	(0x00)	Successful date setting.
FX_INVALID_YEAR	(0x12)	Invalid year specified.
FX_INVALID_MONTH	(0x13)	Invalid month specified.
FX_INVALID_DAY	(0x14)	Invalid day specified.

Allowed From

Initialization, threads

Example

```
UINT            status;

/* Set the system date to December 12, 2005. */
status = fx_system_date_set(2005, 12, 12);

/* If status equals FX_SUCCESS, the file system date is now
   12-12-2005. */
```

See Also

fx_system_date_get, fx_system_initialize, fx_system_time_get, fx_system_time_set

fx_system_initialize

Initializes entire system

Prototype

```
VOID fx_system_initialize(void)
```

Description

This service initializes all the major FileX data structures. It should be called either in ***tx_application_define*** or possibly from an initialization thread and must be called prior to using any other FileX service.

*Once initialized by this call, the application should call **fx_system_date_set** and **fx_system_time_set** to start with an accurate system date and time.*

Input Parameters

None.

Return Values

None.

Allowed From

Initialization, threads

Example

```
void tx_application_define(VOID *free_memory)
{

  UINT status;

  /* Initialize the FileX system. */
  fx_system_initialize();

  /* Set the file system date. */
  fx_system_date_set(my_year, my_month, my_day);

  /* Set the file system time. */
  fx_system_time_set(my_hour, my_minute, my_second);

  /* Now perform all other initialization and possibly
     FileX media open calls if the corresponding
     driver does not block on the boot sector read. */

  ...
}
```

See Also

fx_system_date_get, fx_system_date_set, fx_system_time_get, fx_system_time_set

fx_system_time_get

Gets current system time

Prototype

```
UINT fx_system_time_get(UINT *hour, UINT *minute, UINT *second)
```

Description

This service retrieves the current system time.

Input Parameters

hour	Pointer to destination for hour.
minute	Pointer to destination for minute.
second	Pointer to destination for second.

Return Values

FX_SUCCESS	(0x00)	Successful system time retrieval.
FX_PTR_ERROR	(0x18)	One or more of the input parameters are NULL.

Allowed From

Threads

Example

```
UINT            status;
UINT            hour;
UINT            minute;
UINT            second;

/* Retrieve the current system time. */
status = fx_system_time_get(&hour, &minute, &second);

/* If status equals FX_SUCCESS, the current system time
   is in the hour, minute, and second variables. */
```

See Also

fx_system_date_get, fx_system_date_set, fx_system_initialize, fx_system_time_set

fx_system_time_set

Sets current system time

Prototype

```
UINT fx_system_time_set(UINT hour, UINT minute, UINT second)
```

Description

This service sets the current system time to that specified by the input parameters.

*This service should be called shortly after **fx_system_initialize** to set the initial system time. By default, the system time is 0:0:0.*

Input Parameters

hour	New hour (0-23).
minute	New minute (0-59).
second	New second (0-59).

Return Values

FX_SUCCESS	(0x00)	Successful system time retrieval.
FX_INVALID_HOUR	(0x15)	New hour is invalid.
FX_INVALID_MINUTE	(0x16)	New minute is invalid.
FX_INVALID_SECOND	(0x17)	New second is invalid.

Allowed From

Initialization, threads

Example

```
UINT            status;

/* Set the current system time to hour 23, minute 21, and
   second 20. */
status = fx_system_time_set(23, 21, 20);
/* If status is FX_SUCCESS, the current system time has been
   set. */
```

See Also

fx_system_date_get, fx_system_date_set, fx_system_initialize, fx_system_time_get

fx_unicode_directory_create

Creates a Unicode directory

Prototype

```
UINT  fx_unicode_directory_create(FX_MEDIA *media_ptr,
                                   UCHAR *source_unicode_name,
                                   ULONG source_unicode_length,
                                   CHAR *short_name)
```

Description

This service creates a Unicode-named subdirectory in the current default directory—no path information is allowed in the Unicode source name parameter. If successful, the short name (8.3 format) of the newly created Unicode subdirectory is returned by the service.

All operations on the Unicode subdirectory (making it the default path, deleting, etc.) should be done by supplying the returned short name (8.3 format) to the standard FileX directory services.

This service is not supported on exFAT media.

Input Parameters

media_ptr	Pointer to media control block.
source_unicode_name	Pointer to the Unicode name for the new subdirectory.
source_unicode_length	Length of Unicode name.
short_name	Pointer to destination for short name (8.3 format) for the new Unicode subdirectory.

Return Values

FX_SUCCESS	(0x00)	Successful Unicode directory create.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified directory already exists.
FX_NO_MORE_SPACE	(0x0A)	No more clusters available in the media for the new directory entry.

FX_NOT_IMPLEMENTED	(0x22)	Service not implemented for exFAT file system.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.
FX_IO_ERROR	(0x90)	Driver I/O error.

Allowed From

Threads

Example

```
FX_MEDIA        ram_disk;
UCHAR           my_short_name[13];
UCHAR           my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
   0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
   0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
   0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
   0x63,0x00, 0x00,0x00};

/* Create a Unicode subdirectory with the name contained in
   "my_unicode_name".  */
length =  fx_unicode_directory_create(&ram_disk, my_unicode_name,
                17, my_short_name);

/* If successful, the Unicode subdirectory is created and
   "my_short_name" contains the 8.3 format name that can be used
   with other FileX services. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_rename

fx_unicode_directory_rename

Renames directory using Unicode string

Prototype

```
UINT fx_unicode_directory_rename(FX_MEDIA *media_ptr,
                                  UCHAR *old_unicode_name,
                                  ULONG old_unicode_length,
                                  UCHAR *new_unicode_name,
                                  ULONG new_unicode_length,
                                  CHAR *new_short_name)
```

Description

This service changes a Unicode-named subdirectory to specified new Unicode name in current working directory. The Unicode name parameters must not have path information.

This service is not supported on exFAT media.

Input Parameters

media_ptr	Pointer to media control block.
old_unicode_name	Pointer to the Unicode name for the current file.
old_unicode_name_length	Length of current Unicode name.
new_unicode_name	Pointer to the new Unicode file name.
old_unicode_name_length	Length of new Unicode name..
new_short_name	Pointer to destination for short name (8.3 format) for the renamed Unicode file.

Return Values

FX_SUCCESS	(0x00)	Successful media open.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified directory name already exists.

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	One or more pointers are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.
FX_WRITE_PROTECT	(0x23)	Specified media is write-protected.

Allowed From

Threads

Example

```
FX_MEDIA                  my_media;
UINT     status;
UCHAR    my_short_name[13];
UCHAR    my_old_unicode_name[] = {'a', '\0', 'b', '\0', 'c', '\0',
'\0', '\0'};
UCHAR    my_new_unicode_name[] = {'d', '\0', 'e', '\0', 'f', '\0',
'\0', '\0'};

/* Change the Unicode-named file "abc" to "def".  */
status = fx_unicode_directory_rename(&my_media,
   my_old_unicode_name, 3,
   my_new_unicode_name, 3,
   my_short_name);
/* If status equals FX_SUCCESS, the directory was changed to "def"
and "my_short_name" contains the 8.3 format name that can be used
with other FileX services. */
```

See Also

fx_directory_attributes_read, fx_directory_attributes_set, fx_directory_create, fx_directory_default_get, fx_directory_default_set, fx_directory_delete, fx_directory_first_entry_find, fx_directory_first_full_entry_find, fx_directory_information_get, fx_directory_local_path_clear, fx_directory_local_path_get, fx_directory_local_path_restore, fx_directory_local_path_set, fx_directory_long_name_get, fx_directory_name_test, fx_directory_next_entry_find, fx_directory_next_full_entry_find, fx_directory_rename, fx_directory_short_name_get, fx_unicode_directory_create

fx_unicode_file_create

Creates a Unicode file

Prototype

```
UINT  fx_unicode_file_create(FX_MEDIA *media_ptr,
                             UCHAR *source_unicode_name,
                             ULONG source_unicode_length,
                             CHAR *short_name)
```

Description

This service creates a Unicode-named file in the current default directory—no path information is allowed in the Unicode source name parameter. If successful, the short name (8.3 format) of the newly created Unicode file is returned by the service.

All operations on the Unicode file (opening, writing, reading, closing, etc.) should be done by supplying the returned short name (8.3 format) to the standard FileX file services.

Input Parameters

media_ptr	Pointer to media control block.
source_unicode_name	Pointer to the Unicode name for the new file.
source_unicode_length	Length of Unicode name.
short_name	Pointer to destination for short name (8.3 format) for the new Unicode file.

Return Values

FX_SUCCESS	(0x00)	Successful file create.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified file already exists.
FX_NO_MORE_SPACE	(0x0A)	No more clusters available in the media for the new file entry.
FX_NOT_IMPLEMENTED	(0x22)	Service not implemented for exFAT file system.

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_WRITE_PROTECT	(0x23)	Specified media is write protected.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA         ram_disk;
UCHAR            my_short_name[13];
UCHAR            my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
   0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
   0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
   0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
   0x63,0x00, 0x00,0x00};

/* Create a Unicode file with the name contained in
   "my_unicode_name".  */
length =  fx_unicode_file_create(&ram_disk, my_unicode_name, 17,
                 my_short_name);

/* If successful, the Unicode file is created and "my_short_name"
   contains the 8.3 format name that can be used with other FileX
   services. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_unicode_file_rename

Renames a file using unicode string

Prototype

```
UINT fx_unicode_file_rename(FX_MEDIA *media_ptr,
                            UCHAR *old_unicode_name,
                            ULONG old_unicode_length,
                            UCHAR *new_unicode_name,
                            ULONG new_unicode_length,
                            CHAR *new_short_name)
```

Description

This service changes a Unicode-named file name to specified new Unicode name in current default directory. The Unicode name parameters must not have path information.

i *This service is not supported on exFAT media.*

Input Parameters

media_ptr Pointer to media control block.

old_unicode_name Pointer to the Unicode name for the current file.

old_unicode_name_length
Length of current Unicode name.

new_unicode_name Pointer to the new Unicode file name.

old_unicode_name_length
Length of new Unicode name..

new_short_name Pointer to destination for short name (8.3 format) for the renamed Unicode file.

Return Values

FX_SUCCESS	(0x00)	Successful media open.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_ALREADY_CREATED	(0x0B)	Specified file name already exists.

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_PTR_ERROR	(0x18)	One or more pointers are NULL.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.
FX_WRITE_PROTECT	(0x23)	Specified media is write-protected.

Allowed From

Threads

Example

```
FX_MEDIA                  my_media;
UINT     status;
UCHAR    my_short_name[13];
UCHAR    my_old_unicode_name[] = {'a', '\0', 'b', '\0', 'c', '\0',
'\0', '\0'};
UCHAR    my_new_unicode_name[] = {'d', '\0', 'e', '\0', 'f', '\0',
'\0', '\0'};

/* Change the Unicode-named file "abc" to "def".  */
status = fx_unicode_file_rename(&my_media, my_old_unicode_name, 3,
my_new_unicode_name, 3, my_short_name);

/* If status equals FX_SUCCESS, the file name was changed to "def"
and "my_short_name" contains the 8.3 format name that can be used
with other FileX services. */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_name_get, fx_unicode_short_name_get

fx_unicode_length_get

Gets length of Unicode name

Prototype

```
ULONG  fx_unicode_length_get(UCHAR *unicode_name)
```

Description

This service determines the length of the supplied Unicode name. A Unicode character is represented by two bytes. A Unicode name is a series of two byte Unicode characters terminated by two NULL bytes (two bytes of 0 value).

Input Parameters

unicode_name	Pointer to Unicode name.

Return Values

length	Length of Unicode name (number of Unicode characters in the name).

Allowed From

Threads

Example

```
UCHAR my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
   0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
   0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
   0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
   0x63,0x00, 0x00,0x00};
UINT length;

/* Get the length of "my_unicode_name".  */
length =  fx_unicode_length_get(my_unicode_name);

/* A value of 17 will be returned for the length of the
   "my_unicode_name".  */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

fx_unicode_length_get_extended

Gets length of Unicode name

Prototype

```
UINT  fx_unicode_length_get_extended(UCHAR *unicode_name,
                                      UINT buffer_length)
```

Description

This service gets the length of the supplied Unicode name. A Unicode character is represented by two bytes. A Unicode name is a series of two-byte Unicode characters terminated by two NULL bytes (two bytes of 0 value).

*This service is identical to **fx_unicode_length_get()** except the caller passes in the size of the **unicode_name** buffer, including the two NULL characters.*

Input Parameters

unicode_name	Pointer to Unicode name.
buffer_length	Size of Unicode name buffer.

Return Values

length	Length of Unicode name (number of Unicode characters in the name).

Allowed From

Threads

Example

```
UCHAR my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
   0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
   0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
   0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
   0x63,0x00, 0x00,0x00};
UINT length;

/* Get the length of "my_unicode_name".  */
length =  fx_unicode_length_get_extended(my_unicode_name,
                sizeof(my_unicode_name));

/* A value of 17 will be returned for the length of the
"my_unicode_name".  */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename,fx_unicode_name_get fx_unicode_short_name_get

fx_unicode_name_get

Gets Unicode name from short name

Prototype

```
UINT  fx_unicode_name_get(FX_MEDIA *media_ptr, CHAR *source_short_name,
                            UCHAR *destination_unicode_name,
                            ULONG *destination_unicode_length)
```

Description

This service retrieves the Unicode-name associated with the supplied short name (8.3 format) within the current default directory—no path information is allowed in the short name parameter. If successful, the Unicode name associated with the short name is returned by the service.

This service can be used to get Unicode names for both files and subdirectories.

Input Parameters

media_ptr	Pointer to media control block.
short_name	Pointer to short name (8.3 format).
destination_unicode_name	Pointer to the destination for the Unicode name associated with the supplied short name.
destination_unicode_length	Pointer to returned Unicode name length.

Return Values

FX_SUCCESS	(0x00)	Successful Unicode name retrieval.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT table.
FX_FILE_CORRUPT	(0x08)	File is corrupted
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.

FX_NOT_FOUND	(0x04)	Short name was not found or the Unicode destination size is too small.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA          ram_disk;
UCHAR             my_unicode_name[256*2];
ULONG             unicode_name_length;

/* Get the Unicode name associated with the short name
   "ABC0~111.TXT". Note that the Unicode destination must have 2
   times the number of maximum characters in the name.  */
length =  fx_unicode_name_get(&ram_disk, "ABC0~111.TXT",
                  my_unicode_name, unicode_name_length);

/* If successful, the Unicode name is returned in
   "my_unicode_name". */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_short_name_get

fx_unicode_name_get_extended

Gets Unicode name from short name

Prototype

```
UINT  fx_unicode_name_get_extended(FX_MEDIA *media_ptr,
                              CHAR *source_short_name,
                              UCHAR *destination_unicode_name,
                              ULONG *destination_unicode_length,
                              ULONG unicode_name_buffer_length)
```

Description

This service retrieves the Unicode-name associated with the supplied short name (8.3 format) within the current default directory—no path information is allowed in the short name parameter. If successful, the Unicode name associated with the short name is returned by the service.

Note: This service is identical to ***fx_unicode_name_get()***, except the caller supplies the size of the destination Unicode buffer as an input argument. This allows the service to guarantee that it will not overwrite the destination Unicode buffer

i *This service can be used to get Unicode names for both files and subdirectories.*

Input Parameters

media_ptr	Pointer to media control block.
short_name	Pointer to short name (8.3 format).
destination_unicode_name	Pointer to the destination for the Unicode name associated with the supplied short name.
destination_unicode_length	Pointer to returned Unicode name length.
unicode_name_buffer_length	Size of the Unicode name buffer. Note: A NULL terminator is required, which makes an extra byte.

Return Values

FX_SUCCESS	(0x00)	Successful Unicode name retrieval.

FX_FAT_READ_ERROR	(0x03)	Unable to read FAT table.
FX_FILE_CORRUPT	(0x08)	File is corrupted
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Short name was not found or the Unicode destination size is too small.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        ram_disk;
UCHAR           my_unicode_name[256*2];
ULONG           unicode_name_length;

/* Get the Unicode name associated with the short name
"ABC0~111.TXT".
   Note that the Unicode destination must have 2
   times the number of maximum characters in the name.  */
length =  fx_unicode_name_get_extended(&ram_disk, "ABC0~111.TXT",
                my_unicode_name,&unicode_name_length,
                sizeof(ny_unicode_name));

/* If successful, the Unicode name is returned in
   "my_unicode_name". */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_short_name_get

fx_unicode_short_name_get

Gets short name from Unicode name

Prototype

```
UINT  fx_unicode_short_name_get(FX_MEDIA *media_ptr,
                                 UCHAR *source_unicode_name,
                                 ULONG source_unicode_length,
                                 CHAR *destination_short_name)
```

Description

This service retrieves the short name (8.3 format) associated with the Unicode-name within the current default directory—no path information is allowed in the Unicode name parameter. If successful, the short name associated with the Unicode name is returned by the service.

This service can be used to get short names for both files and subdirectories.

Input Parameters

media_ptr Pointer to media control block.

source_unicode_name Pointer to Unicode name.

source_unicode_length Length of Unicode name.

destination_short_name Pointer to destination for the short name (8.3 format). This must be at least 13 bytes in size.

Return Values

FX_SUCCESS	(0x00)	Successful short name retrieval.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT table.
FX_FILE_CORRUPT	(0x08)	File is corrupted
FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Unicode name was not found.
FX_NOT_IMPLEMENTED	(0x22)	Service not implemented for exFAT file system.

FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
FX_MEDIA        ram_disk;
UCHAR           my_short_name[13];
UCHAR           my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
    0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
    0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
    0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
    0x63,0x00, 0x00,0x00};
/* Get the short name associated with the Unicode name contained in
    the array "my_unicode_name".  */
length =  fx_unicode_short_name_get(&ram_disk, my_unicode_name, 17,
                          my_short_name);
/* If successful, the short name is returned in "my_short_name". */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get

fx_unicode_short_name_get_extended

Gets short name from Unicode name

Prototype

```
UINT  fx_unicode_short_name_get_extended(FX_MEDIA *media_ptr,
                                UCHAR *source_unicode_name,
                                ULONG source_unicode_length,
                                CHAR *destination_short_name,
                                ULONG short_name_buffer_length)
```

Description

This service retrieves the short name (8.3 format) associated with the Unicode-name within the current default directory—no path information is allowed in the Unicode name parameter. If successful, the short name associated with the Unicode name is returned by the service.

i *This service is identical to **fx_unicode_short_name_get()**, except the caller supplies the size of the destination buffer as an input argument. This allows the service to guarantee the short name does not exceed the destination buffer.*

This service can be used to get short names for both files and subdirectories

Input Parameters

media_ptr Pointer to media control block.

source_unicode_name Pointer to Unicode name.

source_unicode_length Length of Unicode name.

destination_short_name Pointer to destination for the short name (8.3 format). This must be at least 13 bytes in size.

short_name_buffer_length
Size of the destination buffer. The buffer size must be at least 14 bytes.

Return Values

FX_SUCCESS	(0x00)	Successful short name retrieval.
FX_FAT_READ_ERROR	(0x03)	Unable to read FAT table.
FX_FILE_CORRUPT	(0x08)	File is corrupted

FX_IO_ERROR	(0x90)	Driver I/O error.
FX_MEDIA_NOT_OPEN	(0x11)	Specified media is not open.
FX_NOT_FOUND	(0x04)	Unicode name was not found.
FX_NOT_IMPLEMENTED	(0x22)	Service not implemented for exFAT file system.
FX_SECTOR_INVALID	(0x89)	Invalid sector.
FX_PTR_ERROR	(0x18)	Invalid media or name pointers.
FX_CALLER_ERROR	(0x20)	Caller is not a thread.

Allowed From

Threads

Example

```
#define SHORT_NAME_BUFFER_SIZE 13
FX_MEDIA        ram_disk;
UCHAR           my_short_name[SHORT_NAME_BUFFER_SIZE];
UCHAR           my_unicode_name[] =
   {0x38,0xC1, 0x88,0xBC, 0xF8,0xC9, 0x20,0x00,
    0x54,0xD6, 0x7C,0xC7, 0x20,0x00, 0x74,0xC7,
    0x84,0xB9, 0x20,0x00, 0x85,0xC7, 0xC8,0xB2,
    0xE4,0xB2, 0x2E,0x00, 0x64,0x00, 0x6F,0x00,
    0x63,0x00, 0x00,0x00};
/* Get the short name associated with the Unicode name contained in
    the array "my_unicode_name".  */
length =  fx_unicode_short_name_get_extended(&ram_disk,
                               my_unicode_name,
                               17,
my_short_name,SHORT_NAME_BUFFER_SIZE);
/* If successful, the short name is returned in "my_short_name". */
```

See Also

fx_file_allocate, fx_file_attributes_read, fx_file_attributes_set, fx_file_best_effort_allocate, fx_file_close, fx_file_create, fx_file_date_time_set, fx_file_delete, fx_file_extended_allocate, fx_file_extended_best_effort_allocate, fx_file_extended_relative_seek, fx_file_extended_seek, fx_file_extended_truncate, fx_file_extended_truncate_release, fx_file_open, fx_file_read, fx_file_relative_seek, fx_file_rename, fx_file_seek, fx_file_truncate, fx_file_truncate_release, fx_file_write, fx_file_write_notify_set, fx_unicode_file_create, fx_unicode_file_rename, fx_unicode_name_get, fx_unicode_short_name_get

Chapter 5: I/O Drivers for FileX

This chapter contains a description of I/O drivers for Azure RTOS FileX and is designed to help developers write application-specific drivers. Following is a list of main topics covered:

I/O Driver Introduction

FileX supports multiple media devices. The FX_MEDIA structure defines everything required to manage a media device. This structure contains all media information, including the media-specific I/O driver and associated parameters for passing information and status between the driver and FileX. In most systems, there is a unique I/O driver for each FileX media instance.

I/O Driver Entry

Each FileX I/O driver has a single entry function that is defined by the ***fx_media_open*** service call. The driver entry function has the following format:

```
void my_driver_entry(FX_MEDIA *media_ptr)
```

FileX calls the I/O driver entry function to request all physical media access, including initialization and boot sector reading. Requests made to the driver are done sequentially; i.e., FileX waits for the current request to complete before another request is sent.

I/O Driver Requests

Because each I/O driver has a single entry function, FileX makes specific requests through the media control block. Specifically, the ***fx_media_driver_request*** member of FX_MEDIA is used to specify the exact driver request. The I/O driver communicates the success or failure of the request through the ***fx_media_driver_status*** member of FX_MEDIA. If the driver request was successful, FX_SUCCESS is placed in this field before the driver returns. Otherwise, if an error is detected, FX_IO_ERROR is placed in this field.

Driver Initialization

Although the actual driver initialization processing is application specific, it usually consists of data structure initialization and possibly some preliminary hardware initialization. This request is the first made by FileX and is done from within the ***fx_media_open*** service.

If media write protection is detected, the driver ***fx_media_driver_write_protect*** member of FX_MEDIA should be set to FX_TRUE.

The following FX_MEDIA members are used for the I/O driver initialization request:

FX_IP_DRIVER member	Meaning
fx_media_driver_request	FX_DRIVER_INIT

FileX provides a mechanism to inform the application driver when sectors are no longer being used. This is especially useful for FLASH memory managers that must manage all in-use logical sectors mapped to the FLASH.

If such notification of free sectors is required, the application driver simply sets the ***fx_media_driver_free_sector_update*** field in the associated FX_MEDIA structure to FX_TRUE. After set, FileX makes a ***FX_DRIVER_RELEASE_SECTORS*** I/O driver call indicating when one or more consecutive sectors becomes free.

Boot Sector Read

Instead of using a standard read request, FileX makes a specific request to read the media's boot sector. The following FX_MEDIA members are used for the I/O driver boot sector read request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_BOOT_READ
fx_media_driver_buffer	Address of destination for boot sector.

Boot Sector Write

Instead of using a standard write request, FileX makes a specific request to write the media's boot sector. The following FX_MEDIA members are used for the I/O driver boot sector write request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_BOOT_WRITE
fx_media_driver_buffer	Address of source for boot sector.

Sector Read

FileX reads one or more sectors into memory by issuing a read request to the I/O driver. The following FX_MEDIA members are used for the I/O driver read request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_READ
fx_media_driver_logical_sector	Logical sector to read
fx_media_driver_sectors	Number of sectors to read
fx_media_driver_buffer	Destination buffer for sector(s) read

FX_MEDIA member	Meaning
fx_media_driver_data_sector_read	Set to FX_TRUE if a file data sector is requested. Otherwise, FX_FALSE if a system sector (FAT or directory sector) is requested.
fx_media_driver_sector_type	Defines the explicit type of sector requested, as follows: FX_FAT_SECTOR (2) FX_DIRECTORY_SECTOR (3) FX_DATA_SECTOR (4)

Sector Write

FileX writes one or more sectors to the physical media by issuing a write request to the I/O driver. The following FX_MEDIA members are used for the I/O driver write request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_WRITE
fx_media_driver_logical_sector	Logical sector to write
fx_media_driver_sectors	Number of sectors to write
fx_media_driver_buffer	Source buffer for sector(s) to write
fx_media_driver_system_write	Set to FX_TRUE if a system sector is requested (FAT or directory sector). Otherwise, FX_FALSE if a file data sector is requested.
fx_media_driver_sector_type	Defines the explicit type of sector requested, as follows: FX_FAT_SECTOR (2) FX_DIRECTORY_SECTOR (3) FX_DATA_SECTOR (4)

Driver Flush

FileX flushes all sectors currently in the driver's sector cache to the physical media by issuing a flush request to the I/O driver. Of course, if the driver is not caching sectors, this request requires no driver processing. The following FX_MEDIA members are used for the I/O driver flush request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_FLUSH

Driver Abort

FileX informs the driver to abort all further physical I/O activity with the physical media by issuing an abort request to the I/O driver. The driver should not perform any I/O again until it is re-initialized. The following FX_MEDIA members are used for the I/O driver abort request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_ABORT

Release Sectors

If previously selected by the driver during initialization, FileX informs the driver whenever one or more consecutive sectors become free. If the driver is actually a FLASH manager, this information can be used to tell the FLASH manager that these sectors are no longer needed. The following FX_MEDIA members are used for the I/O release sectors request:

FX_MEDIA member	Meaning
fx_media_driver_request	FX_DRIVER_RELEASE_SECTORS
fx_media_driver_logical_sector	Start of free sector
fx_media_driver_sectors	Number of free sectors

Driver Suspension

Because I/O with physical media may take some time, suspending the calling thread is often desirable. Of course, this assumes completion of the underlying I/O operation is interrupt driven. If so, thread suspension is easily implemented with a ThreadX semaphore. After starting the input or output operation, the I/O driver suspends on its own internal I/O semaphore (created with an initial count of zero during driver initialization). As part of the driver I/O completion interrupt processing, the same I/O semaphore is set, which in turn wakes up the suspended thread.

Sector Translation

Because FileX views the media as linear logical sectors, I/O requests made to the I/O driver are made with logical sectors. It is the driver's responsibility to translate between logical sectors and the physical geometry of the media, which may include heads, tracks, and physical sectors. For FLASH and RAM disk media, the logical sectors typically map directory to physical sectors. In any case, here are the typical formulas to perform the logical to physical sector mapping in the I/O driver:

```
              media_ptr -> fx_media_driver_physical_sector =
(media_ptr -> fx_media_driver_logical_sector %
media_ptr -> fx_media_sectors_per_track) + 1;

              media_ptr -> fx_media_driver_physical_head =
(media_ptr -> fx_media_driver_logical_sector/
media_ptr -> fx_media_sectors_per_track) %
media_ptr -> fx_media_heads;

              media_ptr -> fx_media_driver_physical_track =
(media_ptr -> fx_media_driver_logical_sector/
(media_ptr -> fx_media_sectors_per_track *
media_ptr -> fx_media_heads)));
```

Note that physical sectors start at one, while logical sectors start at zero.

Hidden Sectors

Hidden sectors resided prior to the boot record on the media. Because they are really outside the scope of the FAT file system layout, they must be accounted for in each logical sector operation the driver does.

Media Write Protect

The FileX driver can turn on write protect by setting the ***fx_media_driver_write_protect*** field in the media control block. This will cause an error to be returned if any FileX calls are made in an attempt to write to the media.

Sample RAM Driver

The FileX demonstration system is delivered with a small RAM disk driver, which is defined in the file fx_ram_driver.c (shown on the following pages). The driver assumes a 32K memory space and creates a boot record for 256 128-byte sectors. This file provides a good example of how to implement application specific FileX I/O drivers.

```
/**************************************************************************/
/*                                                                        */
/*  FUNCTION                                               RELEASE        */
/*                                                                        */
/*    _fx_ram_driver                                      PORTABLE C      */
/*                                                           5.7          */
/*  AUTHOR                                                                */
/*                                                                        */
/*    William E. Lamie, Express Logic, Inc.                               */
/*                                                                        */
/*  DESCRIPTION                                                           */
/*                                                                        */
/*    This function is the entry point to the generic RAM disk driver     */
/*    that is delivered with all versions of FileX. The format of the     */
/*    RAM disk is easily modified by calling fx_media_format prior        */
/*    to opening the media.                                               */
/*                                                                        */
/*    This driver also serves as a template for developing FileX drivers  */
/*    for actual devices. Simply replace the read/write sector logic with */
/*    calls to read/write from the appropriate physical device            */
/*                                                                        */
/*    FileX RAM/FLASH structures look like the following:                 */
/*                                                                        */
/*          Physical Sector                 Contents                      */
/*                                                                        */
/*              0                       Boot record                       */
/*              1                       FAT Area Start                    */
/*              +FAT Sectors            Root Directory Start              */
/*              +Directory Sectors      Data Sector Start                 */
/*                                                                        */
/*                                                                        */
/*  INPUT                                                                 */
/*                                                                        */
/*    media_ptr                             Media control block pointer   */
/*                                                                        */
/*  OUTPUT                                                                */
/*                                                                        */
/*    None                                                                */
/*                                                                        */
/*  CALLS                                                                 */
/*                                                                        */
/*    _fx_utility_memory_copy               Copy sector memory            */
/*    _fx_utility_16_unsigned_read          Read 16-bit unsigned          */
/*                                                                        */
/*  CALLED BY                                                             */
/*                                                                        */
/*    FileX System Functions                                              */
/*                                                                        */
/*  RELEASE HISTORY                                                       */
/*                                                                        */
/*    DATE              NAME                      DESCRIPTION             */
/*                                                                        */
/*  12-12-2005     William E. Lamie         Initial Version 5.0           */
/*  07-18-2007     William E. Lamie         Modified comment(s),          */
/*                                            resulting in version 5.1    */
/*  03-01-2009     William E. Lamie         Modified comment(s),          */
/*                                            resulting in version 5.2    */
/*  11-01-2015     William E. Lamie         Modified comment(s),          */
/*                                            resulting in version 5.3    */
/*  04-15-2016     William E. Lamie         Modified comment(s),          */
/*                                            resulting in version 5.4    */
/*  04-03-2017     William E. Lamie         Modified comment(s),          */
/*                                            fixed compiler warnings,    */
/*                                            resulting in version 5.5    */
/*  12-01-2018     William E. Lamie         Modified comment(s),          */
/*                                            checked buffer overflow,    */
/*                                            resulting in version 5.6    */
/*  08-15-2019     William E. Lamie         Modified comment(s),          */
/*                                            resulting in version 5.7    */
/*                                                                        */
```

```
/**************************************************************************/
VOID  _fx_ram_driver(FX_MEDIA *media_ptr)
{

UCHAR *source_buffer;
UCHAR *destination_buffer;
UINT   bytes_per_sector;


    /* There are several useful/important pieces of information contained in
       the media structure, some of which are supplied by FileX and others
       are for the driver to setup. The following is a summary of the
       necessary FX_MEDIA structure members:

            FX_MEDIA Member                    Meaning

        fx_media_driver_request             FileX request type. Valid requests from
                                            FileX are as follows:

                                                    FX_DRIVER_READ
                                                    FX_DRIVER_WRITE
                                                    FX_DRIVER_FLUSH
                                                    FX_DRIVER_ABORT
                                                    FX_DRIVER_INIT
                                                    FX_DRIVER_BOOT_READ
                                                    FX_DRIVER_RELEASE_SECTORS
                                                    FX_DRIVER_BOOT_WRITE
                                                    FX_DRIVER_UNINIT

        fx_media_driver_status              This value is RETURNED by the driver.
                                            If the operation is successful, this
                                            field should be set to FX_SUCCESS for
                                            before returning. Otherwise, if an
                                            error occurred, this field should be
                                            set to FX_IO_ERROR.

        fx_media_driver_buffer              Pointer to buffer to read or write
                                            sector data. This is supplied by
                                            FileX.

        fx_media_driver_logical_sector      Logical sector FileX is requesting.

        fx_media_driver_sectors             Number of sectors FileX is requesting.


       The following is a summary of the optional FX_MEDIA structure members:

            FX_MEDIA Member                              Meaning

        fx_media_driver_info                Pointer to any additional information
                                            or memory. This is optional for the
                                            driver use and is setup from the
                                            fx_media_open call. The RAM disk uses
                                            this pointer for the RAM disk memory
                                            itself.

        fx_media_driver_write_protect       The DRIVER sets this to FX_TRUE when
                                            media is write protected. This is
                                            typically done in initialization,
                                            but can be done anytime.

        fx_media_driver_free_sector_update  The DRIVER sets this to FX_TRUE when
                                            it needs to know when clusters are
                                            released. This is important for FLASH
                                            wear-leveling drivers.

        fx_media_driver_system_write        FileX sets this flag to FX_TRUE if the
                                            sector being written is a system sector,
                                            e.g., a boot, FAT, or directory sector.
                                            The driver may choose to use this to
                                            initiate error recovery logic for greater
                                            fault tolerance.
```

```
    fx_media_driver_data_sector_read    FileX sets this flag to FX_TRUE if the
                                        sector(s) being read are file data sectors,
                                        i.e., NOT system sectors.

    fx_media_driver_sector_type         FileX sets this variable to the specific
                                        type of sector being read or written. The
                                        following sector types are identified:

                                                FX_UNKNOWN_SECTOR
                                                FX_BOOT_SECTOR
                                                FX_FAT_SECTOR
                                                FX_DIRECTORY_SECTOR
                                                FX_DATA_SECTOR
 */

/* Process the driver request specified in the media control block.  */
switch (media_ptr -> fx_media_driver_request)
{

case FX_DRIVER_READ:
{

    /* Calculate the RAM disk sector offset. Note the RAM disk memory is pointed to by
       the fx_media_driver_info pointer, which is supplied by the application in the
       call to fx_media_open.  */
    source_buffer =  ((UCHAR *)media_ptr -> fx_media_driver_info) +
        ((media_ptr -> fx_media_driver_logical_sector +
          media_ptr -> fx_media_hidden_sectors) *
         media_ptr -> fx_media_bytes_per_sector);

    /* Copy the RAM sector into the destination.  */
    _fx_utility_memory_copy(source_buffer, media_ptr -> fx_media_driver_buffer,
                            media_ptr -> fx_media_driver_sectors *
                            media_ptr -> fx_media_bytes_per_sector);

    /* Successful driver request.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}

case FX_DRIVER_WRITE:
{

    /* Calculate the RAM disk sector offset. Note the RAM disk memory is pointed to by
       the fx_media_driver_info pointer, which is supplied by the application in the
       call to fx_media_open.  */
    destination_buffer =  ((UCHAR *)media_ptr -> fx_media_driver_info) +
        ((media_ptr -> fx_media_driver_logical_sector +
          media_ptr -> fx_media_hidden_sectors) *
         media_ptr -> fx_media_bytes_per_sector);

    /* Copy the source to the RAM sector.  */
    _fx_utility_memory_copy(media_ptr -> fx_media_driver_buffer, destination_buffer,
                            media_ptr -> fx_media_driver_sectors *
                            media_ptr -> fx_media_bytes_per_sector);

    /* Successful driver request.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}

case FX_DRIVER_FLUSH:
{

    /* Return driver success.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}
```

```
case FX_DRIVER_ABORT:
{

    /* Return driver success.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}

case FX_DRIVER_INIT:
{

    /* FLASH drivers are responsible for setting several fields in the
       media structure, as follows:

            media_ptr -> fx_media_driver_free_sector_update
            media_ptr -> fx_media_driver_write_protect

       The fx_media_driver_free_sector_update flag is used to instruct
       FileX to inform the driver whenever sectors are not being used.
       This is especially useful for FLASH managers so they don't have
       maintain mapping for sectors no longer in use.

       The fx_media_driver_write_protect flag can be set anytime by the
       driver to indicate the media is not writable.  Write attempts made
       when this flag is set are returned as errors.  */

    /* Perform basic initialization here... since the boot record is going
       to be read subsequently and again for volume name requests.  */

    /* Successful driver request.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}

case FX_DRIVER_UNINIT:
{

    /* There is nothing to do in this case for the RAM driver.  For actual
       devices some shutdown processing may be necessary.  */

    /* Successful driver request.  */
    media_ptr -> fx_media_driver_status =  FX_SUCCESS;
    break;
}

case FX_DRIVER_BOOT_READ:
{

    /* Read the boot record and return to the caller.  */

    /* Calculate the RAM disk boot sector offset, which is at the very beginning of
       the RAM disk. Note the RAM disk memory is pointed to by the
       fx_media_driver_info pointer, which is supplied by the application in the
       call to fx_media_open.  */
    source_buffer =  (UCHAR *)media_ptr -> fx_media_driver_info;

    /* For RAM driver, determine if the boot record is valid.  */
    if ((source_buffer[0] != (UCHAR)0xEB)  ||
        ((source_buffer[1] != (UCHAR)0x34)  &&
         (source_buffer[1] != (UCHAR)0x76)) ||          /* exFAT jump code.  */
        (source_buffer[2] != (UCHAR)0x90))
    {

        /* Invalid boot record, return an error!  */
        media_ptr -> fx_media_driver_status =  FX_MEDIA_INVALID;
        return;
    }

    /* For RAM disk only, pickup the bytes per sector.  */
    bytes_per_sector =  _fx_utility_16_unsigned_read(&source_buffer[FX_BYTES_SECTOR]);
```

```
#ifdef FX_ENABLE_EXFAT
        /* if byte per sector is zero, then treat it as exFAT volume.  */
        if (bytes_per_sector == 0 && (source_buffer[1] == (UCHAR)0x76))
        {

            /* Pickup the byte per sector shift, and calculate byte per sector.  */
            bytes_per_sector = (UINT)(1 << source_buffer[FX_EF_BYTE_PER_SECTOR_SHIFT]);
        }
#endif /* FX_ENABLE_EXFAT */

        /* Ensure this is less than the media memory size.  */
        if (bytes_per_sector > media_ptr -> fx_media_memory_size)
        {
            media_ptr -> fx_media_driver_status =  FX_BUFFER_ERROR;
            break;
        }

        /* Copy the RAM boot sector into the destination.  */
        _fx_utility_memory_copy(source_buffer, media_ptr -> fx_media_driver_buffer,
                                bytes_per_sector);

        /* Successful driver request.  */
        media_ptr -> fx_media_driver_status =  FX_SUCCESS;
        break;
    }

    case FX_DRIVER_BOOT_WRITE:
    {

        /* Write the boot record and return to the caller.  */

        /* Calculate the RAM disk boot sector offset, which is at the very beginning of the
           RAM disk. Note the RAM disk memory is pointed to by the fx_media_driver_info
           pointer, which is supplied by the application in the call to fx_media_open.  */
        destination_buffer =  (UCHAR *)media_ptr -> fx_media_driver_info;

        /* Copy the RAM boot sector into the destination.  */
        _fx_utility_memory_copy(media_ptr -> fx_media_driver_buffer, destination_buffer,
                                media_ptr -> fx_media_bytes_per_sector);

        /* Successful driver request.  */
        media_ptr -> fx_media_driver_status =  FX_SUCCESS;
        break;
    }

    default:
    {

        /* Invalid driver request.  */
        media_ptr -> fx_media_driver_status =  FX_IO_ERROR;
        break;
    }
    }
}
```

Chapter 6: FileX Fault Tolerant Module

This chapter contains a description of the Azure RTOS FileX Fault Tolerant Module that is designed to maintain file system integrity if the media loses power or is ejected in the middle of a file write operation.

Following is a list of main topics covered:

FileX Fault Tolerant Module Overview

When an application writes data into a file, FileX updates both data clusters and system information. These updates must be completed as an atomic operation to keep information in the file system coherent. For example, when appending data to a file, FileX needs to find an available cluster in the media, update the FAT chain, update the length filed in the directory entry, and possibly update the starting cluster number in the directory entry. Either a power failure or media ejection can interrupt the sequence of updates, which will leave the file system in an inconsistent state. If the inconsistent state is not corrected, the data being updated can be lost, and because of damage to the system information, subsequent file system operation may damage other files or directories on the media.

The FileX Fault Tolerant Module works by journaling steps required to update a file *before* these steps are applied to the file system. If the file update is successful, these log entries are removed. However, if the file update is interrupted, the log entries are stored on the media. Next time the media is mounted, FileX will detect these log entries from the previous (unfinished) write operation. In such cases, FileX can recover from a failure by either rolling back the changes already made to the file system, or by reapplying the required changes to complete the previous operation. In this way, the FileX Fault Tolerant Module maintains file system integrity if the media loses power during an update operation.

i *The FileX Fault Tolerant Module is not designed to prevent file system corruption caused by physical media corruption with valid data in it.*

After the FileX Fault Tolerant module protects a media, the media must not be mounted by anything other than FileX with Fault Tolerant enabled. Doing so can cause the log entries in the file system to be inconsistent with system information on the media. If the FileX Fault Tolerant module attempts to process log entries after the media is updated by another file system, the recovery procedure may fail, leaving the entire file system in an unpredictable state.

Use of the Fault Tolerant Module

The FileX Fault Tolerant feature is available to all FAT file systems supported by FileX, including FAT12, FAT16, FAT32, and exFAT. To enable the fault tolerant feature, FileX must be built with the symbol ***FX_ENABLE_FAULT_TOLERANT*** defined. At run time, application starts fault tolerant service by calling ***fx_fault_tolerant_enable()*** immediately after the call to ***fx_media_open***. After fault tolerant is enabled, all file write operations to the designated media are protected. By default the fault tolerant module is not enabled.

*Application needs to make sure the file system is not being accessed prior to **fx_fault_tolerant_enable()** being called. If application writes data to the file system prior to fault tolerant enable, the write operation could corrupt the media if prior write operations were not completed, and the file system was not restored using fault tolerant log entries.*

FileX Fault Tolerant Module Log

The FileX fault tolerant log takes up one logical cluster in flash. The index to the starting cluster number of that cluster is recorded in the boot sector of the media, with an offset specified by the symbol ***FX_FAULT_TOLERANT_BOOT_INDEX***. By default this symbol is defined to be 116. This location is chosen because it is marked as reserved in FAT12/16/32 and exFAT specification.

Figure 1, “Log Structure Layout,” on page 256, shows the general layout of the log structure. The log structure contains three sections: Log Header, FAT Chain, and Log Entries.

All multi-byte values stored in the log entries are in Little Endian format.

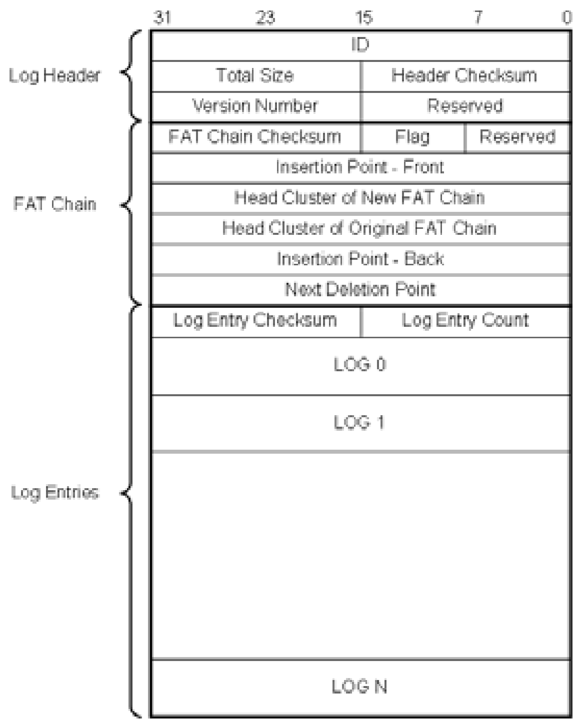

FIGURE 1. Log Structure Layout

The Log Header area contains information that describes the entire log structure and explains each field in detail.

TABLE 1. Log Header Area

Field	Size (in bytes)	Description
ID	4	Identifies a FileX Fault Tolerant Log structure. The log structure is considered invalid if the ID value is not 0x46544C52.
Total Size	2	Indicates the total size (in bytes) of the entire log structure.
Header Checksum	2	Checksum that convers the log header area. The log structure is considered invalid if the header fields fail the checksum verification.
Version Number	2	FileX Fault Tolerant major and minor version numbers.
Reserved	2	For future expansion.

The Log Header area is followed by the FAT Chain Log area. Figure 2 on page 258 contains information that describes how the FAT chain should be modified. This log area contains information on the clusters being allocated to a file, the clusters being removed from a file, and where the insertion/deletion should be and describes each field in the FAT Chain Log area.

TABLE 2. FAT Chain Log Area

Field	Size (in bytes)	Description
FAT Chain Log Checksum	2	Checksum of the entire FAT Chain Log area. The FAT Chain Log area is considered invalid if the it fails the checksum verification.
Flag	1	Valid flag values are: 0x01 FAT Chain Valid 0x02 BITMAP is being used
Reserved	1	Reserved for future use
Insertion Point – Front	4	The cluster (that belongs to the original FAT chain) where the newly created chain is going to be attached to.
Head Cluster of New FAT Chain	4	The first cluster of the newly created FAT Chain
Head Cluster of Original FAT Chain	4	The first cluster of the portion of the original FAT Chain that is to be removed.
Insertion Point – Back	4	The original cluster where the newly created FAT chain joins at.
Next Deletion Point	4	This field assists the FAT chain cleanup procedure.

The Log Entries Area contains log entries that describe the changes needed to recover from a failure. There are three types of log entry supported in the FileX fault tolerant module: FAT Log Entry; Directory Log Entry; and Bitmap Log Entry.

The following three figures and three tables describe these log entries in detail.

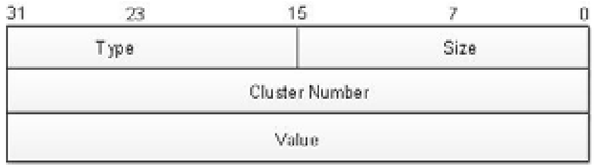

FIGURE 2. FAT Log Entry

TABLE 3. FAT Log Entry

Field	Size (in bytes)	Description
Type	2	Type of Entry, must be FX_FAULT_TOLERANT_FAT_LOG_TYPE
Size	2	Size of this entry
Cluster Number	4	Cluster number
Value	4	Value to be written into the FAT entry

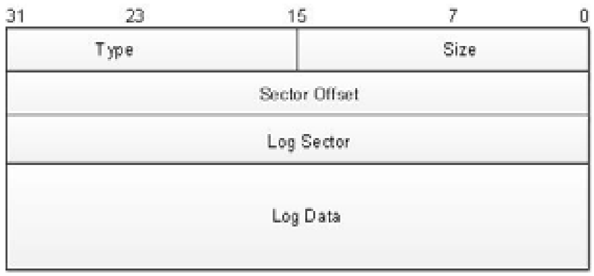

FIGURE 3. Directory Log Entry

TABLE 4. Directory Log Entry

Field	Size (in bytes)	Description
Type	2	Type of Entry, must be FX_FAULT_TOLERANT_DIRECTORY_LOG_TYPE
Size	2	Size of this entry
Sector Offset	4	Offset (in bytes) into the sector where this directory is located.
Log Sector	4	The sector where the directory entry is located
Log Data	Variable	Content of the directory entry

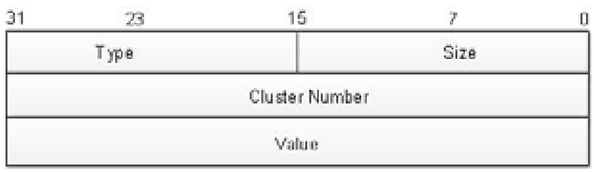

FIGURE 4. Bitmap Log Entry

TABLE 5. Bitmap Log Entry

Field	Size (in bytes)	Description
Type	2	Type of Entry, must be FX_FAULT_TOLERANT_BITMAP_LOG_TYPE
Size	2	Size of this entry
Cluster Number	4	Cluster number
Value	4	Value to be written into the FAT entry

Fault Tolerant Protection

After the FileX Fault Tolerant Module starts, it first searches for an existing fault tolerant log file in the media. If a valid log file cannot be found, FileX considers the media unprotected. In this case FileX will create a fault tolerant log file on the media.

FileX is not able to protect a file system if it was corrupted before the FileX Fault Tolerant Module starts.

If a fault tolerant log file is located, FileX checks for existing log entries. A log file with no log entry indicates prior file operation was successful, and all log entries were removed. In this case the application can start using the file system with fault tolerant protection.

However if log entries are located, FileX needs to either complete the prior file operation, or revert the changes already applied to the file system, effectively undo the changes. In either case, after the log entries are applied to the file system, the file system is restored into a coherent state, and application can start using the file system again.

For media protected by FileX, during file update operation, the data portion is written directly to the media. As FileX writes data, it also records any changes needed to be applied to directory entries, FAT table. This information is recorded in the file tolerant log entries. This approach guarantees that updates to the file system occur after the data is written to the media. If the media is ejected during the data-write phase, crucial file system information has not been changed yet. Therefore the file system is not affected by the interruption.

After all the data is successfully written to the media, FileX then follows information in the log entries to applies the changes to system information, one entry at a time. After all the system information is committed to the media, the log entries are removed from the fault tolerant log. At this point, FileX completes the file update operation.

During file update operation, files are not updated in place. The fault tolerant module allocates a sector for the data to write the new data into, and then remove the sector that contains the data to be overwritten, updating related FAT entries to link the new sector into the chian. For situations in which partial data in a cluster needs to be modified, FileX always allocates new clusters, writes the entire data from the old clusters with updated data into the new clusters, then frees up the old clusters. This guarantees that if the file update is interrupted, the original file is intact. The application needs to be aware that under FileX fault tolerant protection, updating data in a file requires the media to have enough free space to hold new data before sectors with old data can be released. If the media doesn't have enough space to hold new data, the update operation fails.

Appendix A: FileX Services

System Services

```
UINT     fx_system_date_get(UINT *year,
            UINT *month,
            UINT *day);

UINT     fx_system_date_set(UINT year,
            UINT month,
            UINT day);

UINT     fx_system_time_get(UINT *hour,
            UINT *minute,
            UINT *second);

UINT     fx_system_time_set(UINT hour,
            UINT minute,
            UINT second);

VOID     fx_system_initialize(VOID);
```

Media Services

```
UINT     fx_media_abort(FX_MEDIA  *media_ptr);

UINT     fx_media_cache_invalidate(FX_MEDIA  *media_ptr);

UINT     fx_media_check(FX_MEDIA *media_ptr,
            UCHAR *scratch_memory_ptr,
            ULONG scratch_memory_size,
            ULONG error_correction_option,
            ULONG *errors_detected_ptr);

UINT     fx_media_close(FX_MEDIA  *media_ptr);

UINT     fx_media_close_notify_set(FX_MEDIA *media_ptr,
            VOID (*media_close_notify)(FX_MEDIA *media));

UINT     fx_media_exFAT_format(FX_MEDIA *media_ptr,
            VOID (*driver)(FX_MEDIA *media),
            VOID *driver_info_ptr,
            UCHAR *memory_ptr,
            UINT memory_size,
            CHAR *volume_name,
            UINT number_of_fats,
            ULONG64 hidden_sectors,
            ULONG64 total_sectors,
            UINT bytes_per_sector,
            UINT sectors_per_cluster,
            UINT volume_serial_number,
            UINT boundary_unit);

UINT     fx_media_extended_space_available(FX_MEDIA *media_ptr,
            ULONG64 *available_bytes_ptr);

UINT     fx_media_flush(FX_MEDIA  *media_ptr);

UINT     fx_media_format(FX_MEDIA *media_ptr,
            VOID (*driver)(FX_MEDIA *media),
            VOID *driver_info_ptr,
            UCHAR *memory_ptr,
            UINT memory_size,
```

```
            CHAR *volume_name,
            UINT number_of_fats,
            UINT directory_entries,
            UINT hidden_sectors,
            ULONG total_sectors,
            UINT bytes_per_sector,
            UINT sectors_per_cluster,
            UINT heads,
            UINT sectors_per_track);

UINT     fx_media_open(FX_MEDIA *media_ptr,
            CHAR *media_name,
            VOID (*media_driver)(FX_MEDIA *),
            VOID *driver_info_ptr,
            VOID *memory_ptr,
            ULONG memory_size);

UINT     fx_media_open_notify_set(FX_MEDIA *media_ptr,
            VOID (*media_open_notify)(FX_MEDIA *media));

UINT     fx_media_read(FX_MEDIA *media_ptr,
            ULONG logical_sector,
            VOID *buffer_ptr);

UINT     fx_media_space_available(FX_MEDIA *media_ptr,
            ULONG *available_bytes_ptr);

UINT     fx_media_volume_get(FX_MEDIA *media_ptr,
            CHAR *volume_name,
            UINT volume_source);

UINT     fx_media_volume_get_extended(FX_MEDIA *media_ptr,
            CHAR *volume_name,
            UINT volume_name_buffer_length,
            UINT volume_source);

UINT     fx_media_volume_set(FX_MEDIA *media_ptr,
            CHAR *volume_name);

UINT     fx_media_write(FX_MEDIA *media_ptr,
            ULONG logical_sector,
            VOID *buffer_ptr);
```

Directory Services

```
UINT     fx_directory_attributes_read(FX_MEDIA *media_ptr,
            CHAR *directory_name,
            UINT *attributes_ptr);

UINT     fx_directory_attributes_set(FX_MEDIA *media_ptr,
            CHAR *directory_name,
            UINT attributes);

UINT     fx_directory_create(FX_MEDIA *media_ptr,
            CHAR *directory_name);

UINT     fx_directory_default_get(FX_MEDIA *media_ptr,
            CHAR **return_path_name);

UINT     fx_directory_default_set(FX_MEDIA *media_ptr,
            CHAR *new_path_name);
```

```
UINT     fx_directory_delete(FX_MEDIA *media_ptr,
            CHAR *directory_name);

UINT     fx_directory_first_entry_find(FX_MEDIA *media_ptr,
            CHAR *directory_name);

UINT     fx_directory_first_full_entry_find(FX_MEDIA
            *media_ptr, CHAR *directory_name,
            UINT *attributes,
            ULONG *size,
            UINT *year,
            UINT *month,
            UINT *day,
            UINT *hour,
            UINT *minute,
            UINT *second);

UINT     fx_directory_information_get(FX_MEDIA *media_ptr,
            CHAR *directory_name,
            UINT *attributes,
            ULONG *size,
            UINT *year,
            UINT *month,
            UINT *day,
            UINT *hour,
            UINT *minute,
            UINT *second);

UINT     fx_directory_local_path_clear(FX_MEDIA *media_ptr);

UINT     fx_directory_local_path_get(FX_MEDIA *media_ptr,
            CHAR **return_path_name);

UINT     fx_directory_local_path_restore(FX_MEDIA *media_ptr,
            FX_LOCAL_PATH *local_path_ptr);

UINT     fx_directory_local_path_set(FX_MEDIA *media_ptr,
            FX_LOCAL_PATH *local_path_ptr,
            CHAR *new_path_name);

UINT     fx_directory_long_name_get(FX_MEDIA *media_ptr,
            CHAR *short_name,
            CHAR *long_name);

UINT  fx_directory_long_name_get_extended(FX_MEDIA *media_ptr,
            CHAR *short_name,
            CHAR *long_name
            UINT long_file_name_buffer_length);

UINT     fx_directory_name_test(FX_MEDIA *media_ptr,
            CHAR *directory_name);

UINT     fx_directory_next_entry_find(FX_MEDIA *media_ptr,
            CHAR *directory_name);

UINT     fx_directory_next_full_entry_find(FX_MEDIA *media_ptr,
            CHAR *directory_name,
            UINT *attributes,
            ULONG *size,
            UINT *year,
            UINT *month,
            UINT *day,
            UINT *hour,
```

```
                 UINT *minute,
                 UINT *second);

UINT          fx_directory_rename(FX_MEDIA *media_ptr,
                 CHAR *old_directory_name,
                 CHAR *new_directory_name);

UINT          fx_directory_short_name_get(FX_MEDIA *media_ptr,
                 CHAR *long_name,
                 CHAR *short_name);

UINT          fx_directory_short_name_get_extended(FX_MEDIA
                 *media_ptr,
                 CHAR *long_name, CHAR *short_name
                 UINT short_file_name_length);
```

File Services

```
UINT          fx_fault_tolerant_enable(FX_MEDIA *media_ptr,
                 VOID *memory_buffer,
                 UINT memory_size);

UINT          fx_file_allocate(FX_FILE *file_ptr,
                 ULONG size);

UINT          fx_file_attributes_read(FX_MEDIA *media_ptr,
                 CHAR *file_name,
                 UINT *attributes_ptr);

UINT          fx_file_attributes_set(FX_MEDIA *media_ptr,
                 CHAR *file_name,
                 UINT attributes);

UINT          fx_file_best_effort_allocate(FX_FILE *file_ptr,
                 ULONG size,
                 ULONG *actual_size_allocated);

UINT          fx_file_close(FX_FILE *file_ptr);

UINT          fx_file_create(FX_MEDIA *media_ptr,
                 CHAR *file_name);

UINT          fx_file_date_time_set(FX_MEDIA *media_ptr,
                 CHAR *file_name,
                 UINT year,
                 UINT month,
                 UINT day,
                 UINT hour,
                 UINT minute,
                 UINT second);

UINT          fx_file_delete(FX_MEDIA *media_ptr,
                 CHAR *file_name);

UINT          fx_file_extended_allocate(FX_FILE *file_ptr,
                 ULONG64 size);

UINT          fx_file_extended_best_effort_allocate(
                 FX_FILE *file_ptr,
                 ULONG64 size,
                 ULONG64 *actual_size_allocated);
```

```
UINT     fx_file_extended_relative_seek(FX_FILE *file_ptr,
            ULONG64 byte_offset,
            UINT seek_from);

UINT     fx_file_extended_seek(FX_FILE *file_ptr,
            ULONG64 byte_offset);

UINT     fx_file_extended_truncate(FX_FILE *file_ptr,
            ULONG64 size);

UINT     fx_file_extended_truncate_release(FX_FILE *file_ptr,
            ULONG64 size);

UINT     fx_file_open(FX_MEDIA *media_ptr,
            FX_FILE *file_ptr,
            CHAR *file_name,
            UINT open_type);

UINT     fx_file_read(FX_FILE *file_ptr,
            VOID *buffer_ptr,
            ULONG request_size,
            ULONG *actual_size);

UINT     fx_file_relative_seek(FX_FILE *file_ptr,
            ULONG byte_offset,
            UINT seek_from);

UINT     fx_file_rename(FX_MEDIA *media_ptr,
            CHAR *old_file_name,
            CHAR *new_file_name);

UINT     fx_file_seek(FX_FILE *file_ptr,
            ULONG byte_offset);

UINT     fx_file_truncate(FX_FILE *file_ptr,
            ULONG size);

UINT     fx_file_truncate_release(FX_FILE *file_ptr,
            ULONG size);

UINT     fx_file_write(FX_FILE *file_ptr,
            VOID *buffer_ptr,
            ULONG size);

UINT     fx_file_write_notify_set(FX_FILE *file_ptr,
            VOID (*file_write_notify)(FX_FILE *file));
```

Unicode Services

```
UINT     fx_unicode_directory_create(FX_MEDIA *media_ptr,
            UCHAR *source_unicode_name,
            ULONG source_unicode_length,
            CHAR *short_name);

UINT     fx_unicode_directory_rename(FX_MEDIA *media_ptr,
            UCHAR *old_unicode_name,
            ULONG old_unicode_length,
            UCHAR *new_unicode_name,
            ULONG new_unicode_length,
            CHAR *new_short_name);
```

```
UINT     fx_unicode_file_create(FX_MEDIA *media_ptr,
            UCHAR *source_unicode_name,
            ULONG source_unicode_length,
            CHAR *short_name);

UINT     fx_unicode_file_rename(FX_MEDIA *media_ptr,
            UCHAR *old_unicode_name,
            ULONG old_unicode_length,
            UCHAR *new_unicode_name,
            ULONG new_unicode_length,
            CHAR *new_short_name);

ULONG    fx_unicode_length_get(UCHAR *unicode_name);

UINT     fx_unicode_length_get_extended(UCHAR *unicode_name,
            UINT buffer_length);

UINT     fx_unicode_name_get(FX_MEDIA *media_ptr,
            CHAR *source_short_name,
            UCHAR *destination_unicode_name,
            ULONG *destination_unicode_length);

UINT     fx_unicode_name_get_extended(FX_MEDIA *media_ptr,
            CHAR *source_short_name,
            UCHAR *destination_unicode_name,
            ULONG *destination_unicode_length,
            ULONG unicode_name_buffer_length);

UINT     fx_unicode_short_name_get(FX_MEDIA *media_ptr,
            UCHAR *source_unicode_name,
            ULONG source_unicode_length,
            CHAR *destination_short_name);

UINT     fx_unicode_short_name_get_extended(FX_MEDIA *media_ptr,
            UCHAR *source_unicode_name,
            ULONG source_unicode_length,
            CHAR *destination_short_name,
            ULONG short_name_buffer_length);
```

Appendix B: FileX Constants

Alphabetic Listings

EXFAT_BIT_MAP_FIRST_TABLE	0
EXFAT_BOOT_REGION_SIZE	24
EXFAT_DEFAULT_BOUNDARY_UNIT	28
EXFAT_FAT_BITS	2
EXFAT_FAT_BYTES_PER_SECTOR_SHIFT	0x009
EXFAT_FAT_DRIVE_SELECT	0x080
EXFAT_FAT_FILE_SYS_REVISION	0x100
EXFAT_FAT_NUM_OF_FATS	0x001
EXFAT_FAT_VOLUME_FLAG	0x000
EXFAT_FAT_VOLUME_NAME_FIELD_SIZE	11
EXFAT_LAST_CLUSTER_MASK	0xFFFFFFFF
EXFAT_MIN_NUM_OF_RESERVED_SECTORS	1
EXFAT_NUM_OF_DIR_ENTRIES	2
FX_12_BIT_FAT_SIZE	4086
FX_12BIT_SIZE	3
FX_16_BIT_FAT_SIZE	65525
FX_ACCESS_ERROR	0x06
FX_ALREADY_CREATED	0x0B
FX_ARCHIVE	0x20
FX_BAD_CLUSTER	0xFFF7
FX_BAD_CLUSTER_32	0x0FFFFFF7
FX_BAD_CLUSTER_EXFAT	0x0FFFFFF7
FX_BASE_YEAR	1980
FX_BIGDOS	0x06
FX_BOOT_ERROR	0x01
FX_BOOT_SECTOR	1
FX_BOOT_SECTOR_SIZE	512
FX_BOOT_SIG	0x026
FX_BUFFER_ERROR	0x21
FX_BYTES_SECTOR	0x00B
FX_CALLER_ERROR	0x20
FX_DATA_SECTOR	4
FX_DAY_MASK	0x1F
FX_DIR_ENTRY_DONE	0x00

FX_DIR_ENTRY_FREE	0xE5
FX_DIR_ENTRY_SIZE	32
FX_DIR_EXT_SIZE	3
FX_DIR_NAME_SIZE	8
FX_DIR_NOT_EMPTY	0x10
FX_DIR_RESERVED	8
FX_DIRECTORY	0x10
FX_DIRECTORY_ERROR	0x02
FX_DIRECTORY_SECTOR	3
FX_DRIVE_NUMBER	0x024
FX_DRIVER_ABORT	3
FX_DRIVER_BOOT_READ	5
FX_DRIVER_BOOT_WRITE	7
FX_DRIVER_FLUSH	2
FX_DRIVER_INIT	4
FX_DRIVER_READ	0
FX_DRIVER_RELEASE_SECTORS	6
FX_DRIVER_UNINIT	8
FX_DRIVER_WRITE	1
FX_EF_BOOT_CODE	120
FX_EF_BYTE_PER_SECTOR_SHIFT	108
FX_EF_CLUSTER_COUNT	92
FX_EF_CLUSTER_HEAP_OFFSET	88
FX_EF_DRIVE_SELECT	111
FX_EF_FAT_LENGTH	84
FX_EF_FAT_OFFSET	80
FX_EF_FILE_SYSTEM_REVISION	104
FX_EF_FIRST_CLUSTER_OF_ROOT_DIR	96
FX_EF_MUST_BE_ZERO	11
FX_EF_NUMBER_OF_FATS	110
FX_EF_PARTITION_OFFSET	64
FX_EF_PERCENT_IN_USE	112
FX_EF_RESERVED	113
FX_EF_SECTOR_PER_CLUSTER_SHIFT	109
FX_EF_VOLUME_FLAGS	106
FX_EF_VOLUME_LENGTH	72

FX_EF_VOLUME_SERIAL_NUMBER	100
FX_END_OF_FILE	0x09
FX_ERROR_FIXED	0x92
FX_ERROR_NOT_FIXED	0x93
FX_EXFAT	0x07
FX_EXFAT_BIT_MAP_NUM_OF_CACHED_SECTORS	1
FX_EXFAT_BITMAP_CLUSTER_FREE	0
FX_EXFAT_BITMAP_CLUSTER_OCCUPIED	1
FX_EXFAT_FAT_CHECK_SUM_OFFSET	11
FX_EXFAT_FAT_MAIN_BOOT_SECTOR_OFFSET	1
FX_EXFAT_FAT_MAIN_SYSTEM_AREA_SIZE	12
FX_EXFAT_FAT_NUM_OF_SYSTEM_AREAS	2
FX_EXFAT_FAT_OEM_PARAM_OFFSET	9
FX_EXFAT_MAX_DIRECTORY_SIZE	0x10000000
FX_EXFAT_SIZE_OF_FAT_ELEMENT_SHIFT	2
FX_FALSE	0
FX_FAT_CACHE_DEPTH	4
FX_FAT_CACHE_HASH_MASK	0x3
FX_FAT_CHAIN_ERROR	0x01
FX_FAT_ENTRY_START	2
FX_FAT_MAP_SIZE	128
FX_FAT_READ_ERROR	0x03
FX_FAT_SECTOR	2
FX_FAT12	0x01
FX_FAT16	0x04
FX_FAT32	0x0B
FX_FAULT_TOLERANT_CACHE_SIZE	1024
FX_FILE_ABORTED_ID	0x46494C41UL
FX_FILE_CLOSED_ID	0x46494C43UL
FX_FILE_CORRUPT	0x08
FX_FILE_ID	0x46494C45UL
FX_FILE_SIZE_ERROR	0x08
FX_FILE_SYSTEM_TYPE	0x036
FX_FREE_CLUSTER	0x0000
FX_HEADS	0x01A
FX_HIDDEN	0x02

FX_HIDDEN_SECTORS	0x01C
FX_HOUR_MASK	0x1F
FX_HOUR_SHIFT	11
FX_HUGE_SECTORS	0x020
FX_INITIAL_DATE	0x4761
FX_INITIAL_TIME	0x0000
FX_INVALID_ATTR	0x19
FX_INVALID_CHECKSUM	0x95
FX_INVALID_DAY	0x14
FX_INVALID_HOUR	0x15
FX_INVALID_MINUTE	0x16
FX_INVALID_MONTH	0x13
FX_INVALID_NAME	0x0C
FX_INVALID_OPTION	0x24
FX_INVALID_PATH	0x0D
FX_INVALID_SECOND	0x17
FX_INVALID_STATE	0x97
FX_INVALID_YEAR	0x12
FX_IO_ERROR	0x90
FX_JUMP_INSTR	0x000
FX_LAST_CLUSTER_1	0xFFF8
FX_LAST_CLUSTER_1_32	0x0FFFFFF8
FX_LAST_CLUSTER_2	0xFFFF
FX_LAST_CLUSTER_2_32	0x0FFFFFFF
FX_LAST_CLUSTER_EXFAT	0x0FFFFFFF
FX_LONG_NAME	0xF
FX_LONG_NAME_ENTRY_LEN	13
FX_LOST_CLUSTER_ERROR	0x04
FX_MAX_12BIT_CLUST	0x0FF0
FX_MAX_EX_FAT_NAME_LEN	255
FX_MAX_FAT_CACHE	256
FX_MAX_LAST_NAME_LEN	256
FX_MAX_LONG_NAME_LEN	256
FX_MAX_SECTOR_CACHE	256
FX_MAX_SHORT_NAME_LEN	13
FX_MAXIMUM_HOUR	23

FX_MAXIMUM_MINUTE	59
FX_MAXIMUM_MONTH	12
FX_MAXIMUM_PATH	256
FX_MAXIMUM_SECOND	59
FX_MAXIMUM_YEAR	2107
FX_MEDIA_ABORTED_ID	0x4D454441UL
FX_MEDIA_CLOSED_ID	0x4D454443UL
FX_MEDIA_ID	0x4D454449UL
FX_MEDIA_INVALID	0x02
FX_MEDIA_NOT_OPEN	0x11
FX_MEDIA_TYPE	0x015
FX_MINUTE_MASK	0x3F
FX_MINUTE_SHIFT	5
FX_MONTH_MASK	0x0F
FX_MONTH_SHIFT	5
FX_NO_FAT	0xFF
FX_NO_MORE_ENTRIES	0x0F
FX_NO_MORE_SPACE	0x0A
FX_NOT_A_FILE	0x05
FX_NOT_AVAILABLE	0x94
FX_NOT_DIRECTORY	0x0E
FX_NOT_ENOUGH_MEMORY	0x91
FX_NOT_FOUND	0x04
FX_NOT_IMPLEMENTED	0x22
FX_NOT_OPEN	0x07
FX_NOT_USED	0x0001
FX_NULL	0
FX_NUMBER_OF_FATS	0x010
FX_OEM_NAME	0x003
FX_OPEN_FOR_READ	0
FX_OPEN_FOR_READ_FAST	2
FX_OPEN_FOR_WRITE	1
FX_PTR_ERROR	0x18
FX_READ_CONTINU	0x96
FX_READ_ONLY	0x01
FX_RESERVED	0x025

FX_RESERVED_1	0xFFF0
FX_RESERVED_1_32	0x0FFFFFF0
FX_RESERVED_1_EXFAT	0xFFFFFFF8
FX_RESERVED_2	0xFFF6
FX_RESERVED_2_32	0x0FFFFFF6
FX_RESERVED_2_EXFAT	0xFFFFFFFE
FX_RESERVED_SECTOR	0x00E
FX_ROOT_CLUSTER_32	0x02C
FX_ROOT_DIR_ENTRIES	0x011
FX_SECOND_MASK	0x1F
FX_SECTOR_CACHE_DEPTH	4
FX_SECTOR_CACHE_HASH_ENABLE	16
FX_SECTOR_CACHE_HASH_MASK	0x3
FX_SECTOR_INVALID	0x89
FX_SECTORS	0x013
FX_SECTORS_CLUSTER	0x00D
FX_SECTORS_PER_FAT	0x016
FX_SECTORS_PER_FAT_32	0x024
FX_SECTORS_PER_TRK	0x018
FX_SEEK_BACK	3
FX_SEEK_BEGIN	0
FX_SEEK_END	1
FX_SEEK_FORWARD	2
FX_SIG_BYTE_1	0x55
FX_SIG_BYTE_2	0xAA
FX_SIG_OFFSET	0x1FE
FX_SIGN_EXTEND	0xF000
FX_SUCCESS	0x00
FX_SYSTEM	0x04
FX_TRUE	1
FX_UNKNOWN_SECTOR	0
FX_VOLUME	0x08
FX_VOLUME_ID	0x027
FX_VOLUME_LABEL	0x02B
FX_WRITE_PROTECT	0x23
FX_YEAR_MASK	0x7F
FX_YEAR_SHIFT	9

Listings by Value

FX_DIR_ENTRY_DONE	0x00
FX_DRIVER_READ	0
FX_FALSE	0
EXFAT_BIT_MAP_FIRST_TABLE	0
FX_FREE_CLUSTER	0x0000
FX_INITIAL_TIME	0x0000
FX_JUMP_INSTR	0x000
FX_NULL	0
FX_OPEN_FOR_READ	0
FX_SEEK_BEGIN	0
FX_SUCCESS	0x00
FX_UNKNOWN_SECTOR	0
FX_EXFAT_FAT_MAIN_BOOT_SECTOR_OFFSET	0
FX_EXFAT_BITMAP_CLUSTER_FREE	0
EXFAT_FAT_VOLUME_FLAG	0x000
FX_BOOT_ERROR	0x01
FX_BOOT_SECTOR	1
FX_DRIVER_WRITE	1
FX_FAT_CHAIN_ERROR	0x01
FX_NOT_USED	0x0001
FX_OPEN_FOR_WRITE	1
FX_READ_ONLY	0x01
FX_FAT12	0x01
EXFAT_FAT_NUM_OF_FATS	0x001
FX_SEEK_END	1
FX_TRUE	1
FX_EXFAT_BIT_MAP_NUM_OF_CACHED_SECTORS	1
FX_EXFAT_BITMAP_CLUSTER_OCCUPIED	1
FX_EXFAT_FAT_EXT_BOOT_SECTOR_OFFSET	1
EXFAT_MIN_NUM_OF_RESERVED_SECTORS	1
FX_DIRECTORY_ERROR	0x02
FX_HIDDEN	0x02
FX_MEDIA_INVALID	0x02

FX_DRIVER_FLUSH	2
FX_FAT_ENTRY_START	2
FX_FAT_SECTOR	2
FX_OPEN_FOR_READ_FAST	2
FX_SEEK_FORWARD	2
FX_EXFAT_SIZE_OF_FAT_ELEMENT_SHIFT	2
FX_EXFAT_FAT_NUM_OF_SYSTEM_AREAS	2
EXFAT_NUM_OF_DIR_ENTRIES	2
FX_12BIT_SIZE	3
FX_DIR_EXT_SIZE	3
FX_DIRECTORY_SECTOR	3
FX_DRIVER_ABORT	3
FX_FAT_CACHE_HASH_MASK	0x3
FX_FAT_READ_ERROR	0x03
FX_OEM_NAME	0x003
FX_SECTOR_CACHE_HASH_MASK	0x3
FX_SEEK_BACK	3
FX_DATA_SECTOR	4
FX_DRIVER_INIT	4
FX_FAT_CACHE_DEPTH	4
FX_FAT16	0x04
FX_LOST_CLUSTER_ERROR	0x04
FX_NOT_FOUND	0x04
FX_SECTOR_CACHE_DEPTH	4
FX_SYSTEM	0x04
FX_DRIVER_BOOT_READ	5
FX_MINUTE_SHIFT	5
FX_MONTH_SHIFT	5
FX_NOT_A_FILE	0x05
FX_ACCESS_ERROR	0x06
FX_BIGDOS	0x06
FX_DRIVER_RELEASE_SECTORS	6
FX_DRIVER_BOOT_WRITE	7
FX_NOT_OPEN	0x07
FX_EXFAT	0x07

FX_DIR_NAME_SIZE	8
FX_DIR_RESERVED	8
FX_DRIVER_UNINIT	8
FX_FILE_CORRUPT	0x08
FX_FILE_SIZE_ERROR	0x08
FX_VOLUME	0x08
FX_END_OF_FILE	0x09
EXFAT_FAT_BYTES_PER_SECTOR_SHIFT	0x009
FX_YEAR_SHIFT	9
FX_EXFAT_FAT_OEM_PARAM_OFFSET	9
FX_NO_MORE_SPACE	0x0A
FX_EF_MUST_BE_ZERO	11
EXFAT_FAT_VOLUME_NAME_FIELD_SIZE	11
FX_ALREADY_CREATED	0x0B
FX_FAT32	0x0B
FX_BYTES_SECTOR	0x00B
FX_HOUR_SHIFT	11
FX_EXFAT_FAT_CHECK_SUM_OFFSET	11
FX_INVALID_NAME	0x0C
FX_MAXIMUM_MONTH	12
FX_EXFAT_FAT_MAIN_SYSTEM_AREA_SIZE	12
FX_INVALID_PATH	0x0D
FX_SECTORS_CLUSTER	0x00D
FX_LONG_NAME_ENTRY_LEN	13
FX_MAX_SHORT_NAME_LEN	13
FX_NOT_DIRECTORY	0x0E
FX_RESERVED_SECTORS	0x00E
FX_LONG_NAME	0xF
FX_MONTH_MASK	0x0F
FX_NO_MORE_ENTRIES	0x0F
FX_DIR_NOT_EMPTY	0x10
FX_DIRECTORY	0x10
FX_MAX_FAT_CACHE	16
FX_MAX_SECTOR_CACHE	16
FX_NUMBER_OF_FATS	0x010

FX_SECTOR_CACHE_HASH_ENABLE	16
FX_MEDIA_NOT_OPEN	0x11
FX_ROOT_DIR_ENTRIES	0x011
FX_INVALID_YEAR	0x12
FX_INVALID_MONTH	0x13
FX_SECTORS	0x013
FX_INVALID_DAY	0x14
FX_INVALID_HOUR	0x15
FX_MEDIA_TYPE	0x015
FX_INVALID_MINUTE	0x16
FX_SECTORS_PER_FAT	0x016
FX_INVALID_SECOND	0x17
FX_MAXIMUM_HOUR	23
FX_PTR_ERROR	0x18
EXFAT_BOOT_REGION_SIZE	24
FX_SECTORS_PER_TRK	0x018
FX_INVALID_ATTR	0x19
FX_HEADS	0x01A
FX_HIDDEN_SECTORS	0x01C
FX_DAY_MASK	0x1F
FX_HOUR_MASK	0x1F
FX_SECOND_MASK	0x1F
FX_ARCHIVE	0x20
FX_CALLER_ERROR	0x20
FX_DIR_ENTRY_SIZE	32
EXFAT_FAT_BITS	32
FX_HUGE_SECTORS	0x020
FX_BUFFER_ERROR	0x21
FX_MAX_LONG_NAME_LEN	33
FX_NOT_IMPLEMENTED	0x22
FX_WRITE_PROTECT	0x23
FX_DRIVE_NUMBER	0x024
FX_INVALID_OPTION	0x24
FX_SECTORS_PER_FAT_32	0x024
FX_RESERVED	0x025

FX_BOOT_SIG	0x026
FX_VOLUME_ID	0x027
FX_VOLUME_LABEL	0x02B
FX_ROOT_CLUSTER_32	0x02C
FX_FILE_SYSTEM_TYPE	0x036
FX_MAXIMUM_MINUTE	59
FX_MAXIMUM_SECOND	59
FX_MINUTE_MASK	0x3F
FX_EF_PARTITION_OFFSET	64
FX_EF_VOLUME_LENGTH	72
FX_EF_FAT_OFFSET	80
FX_EF_FAT_LENGTH	84
FX_SIG_BYTE_1	0x55
FX_EF_CLUSTER_HEAP_OFFSET	88
FX_EF_CLUSTER_COUNT	92
FX_EF_FIRST_CLUSTER_OF_ROOT_DIR	96
FX_EF_VOLUME_SERIAL_NUMBER	100
FX_EF_FILE_SYSTEM_REVISION	104
FX_EF_VOLUME_FLAGS	106
FX_EF_BYTE_PER_SECTOR_SHIFT	108
FX_EF_SECTOR_PER_CLUSTER_SHIFT	109
FX_EF_NUMBER_OF_FATS	110
FX_EF_DRIVE_SELECT	11
FX_EF_PERCENT_IN_USE	112
FX_EF_RESERVED	113
FX_EF_BOOT_CODE	120
FX_YEAR_MASK	0x7F
EXFAT_FAT_DRIVE_SELECT	0x80
FX_FAT_MAP_SIZE	128
EXFAT_DEFAULT_BOUNDARY_UNIT	128
FX_SECTOR_INVALID	0x89
FX_IO_ERROR	0x90
FX_NOT_ENOUGH_MEMORY	0x91
FX_ERROR_FIXED	0x92
FX_ERROR_NOT_FIXED	0x93

FX_NOT_AVAILABLE	0x94
FX_INVALID_CHECKSUM	0x95
FX_READ_CONTINUE	0x96
FX_INVALID_STATE	0x97
FX_SIG_BYTE_2	0xAA
FX_DIR_ENTRY_FREE	0xE5
FX_NO_FAT	0xFF
EXFAT_FAT_FILE_SYS_REVISION	0x100
FX_MAX_EX_FAT_NAME_LEN	255
FX_MAXIMUM_PATH	256
FX_SIG_OFFSET	0x1FE
FX_BOOT_SECTOR_SIZE	512
FX_FAULT_TOLERANT_CACHE_SIZE	1024
FX_BASE_YEAR	1980
FX_MAXIMUM_YEAR	2107
FX_MAX_12BIT_CLUST	0x0FF0
FX_12_BIT_FAT_SIZE	4086
FX_INITIAL_DATE	0x4761
FX_SIGN_EXTEND	0xF000
FX_RESERVED_1	0xFFF0
FX_16_BIT_FAT_SIZE	65525
FX_RESERVED_2	0xFFF6
FX_BAD_CLUSTER	0xFFF7
FX_LAST_CLUSTER_1	0xFFF8
FX_LAST_CLUSTER_2	0xFFFF
FX_RESERVED_1_32	0x0FFFFFF0
FX_RESERVED_2_32	0x0FFFFFF6
FX_BAD_CLUSTER_32	0x0FFFFFF7
FX_LAST_CLUSTER_1_32	0x0FFFFFF8
FX_LAST_CLUSTER_2_32	0x0FFFFFFF
FX_EXFAT_MAX_DIRECTORY_SIZE	0x10000000
FX_FILE_ABORTED_ID	0x46494C41UL
FX_FILE_CLOSED_ID	0x46494C43UL
FX_FILE_ID	0x46494C45UL
FX_MEDIA_ABORTED_ID	0x4D454441UL

FX_MEDIA_CLOSED_ID	0x4D454443UL
FX_MEDIA_ID	0x4D454449UL
FX_RESERVED_1_EXFAT	0xFFFFFFF8
FX_RESERVED_2_EXFAT	0xFFFFFFFE
FX_BAD_CLUSTER_EXFAT	0xFFFFFFF7
FX_LAST_CLUSTER_EXFAT	0xFFFFFFFF
EXFAT_LAST_CLUSTER_MASK	0xFFFFFFFF

Appendix C: FileX Data Types

FX_DIR_ENTRY

```
typedef struct FX_DIR_ENTRY_STRUCT
{

    CHAR             *fx_dir_entry_name;
    CHAR              fx_dir_entry_short_name[FX_MAX_SHORT_NAME_LEN];
    UINT              fx_dir_entry_long_name_present;
    UINT              fx_dir_entry_long_name_shorted;
    UCHAR             fx_dir_entry_attributes;
    UCHAR             fx_dir_entry_reserved;
    UCHAR             fx_dir_entry_created_time_ms;
    UINT              fx_dir_entry_created_time;
    UINT              fx_dir_entry_created_date;
    UINT              fx_dir_entry_last_accessed_date;
    UINT              fx_dir_entry_time;
    UINT              fx_dir_entry_date;
    ULONG             fx_dir_entry_cluster;
    ULONG64           fx_dir_entry_file_size;
    ULONG64           fx_dir_entry_log_sector;
    ULONG             fx_dir_entry_byte_offset;
    ULONG             fx_dir_entry_number;
    ULONG             fx_dir_entry_last_search_cluster;
    ULONG             fx_dir_entry_last_search_relative_cluster;
    ULONG64           fx_dir_entry_last_search_log_sector;
    ULONG             fx_dir_entry_last_search_byte_offset;
    ULONG64           fx_dir_entry_next_log_sector;

#ifdef FX_ENABLE_EXFAT
    CHAR              fx_dir_entry_dont_use_fat;
    UCHAR             fx_dir_entry_type;
    ULONG64           fx_dir_entry_available_file_size;
    ULONG             fx_dir_entry_secondary_count;
#endif
} FX_DIR_ENTRY;
```

FX_PATH

```
typedef struct FX_PATH_STRUCT
{
    FX_DIR_ENTRY      fx_path_directory;
    CHAR              fx_path_string[FX_MAXIMUM_PATH];
    CHAR              fx_path_name_buffer[FX_MAX_LONG_NAME_LEN];
    ULONG             fx_path_current_entry;
} FX_PATH;


typedef FX_PATH FX_LOCAL_PATH;
```

FX_CACHED_SECTOR

```
typedef struct FX_CACHED_SECTOR_STRUCT
{
    UCHAR            *fx_cached_sector_memory_buffer;
    ULONG             fx_cached_sector;
```

```
    UCHAR             fx_cached_sector_buffer_dirty;
    UCHAR             fx_cached_sector_valid;
    UCHAR             fx_cached_sector_type;
    UCHAR             fx_cached_sector_reserved;
    struct FX_CACHED_SECTOR_STRUCT
                     *fx_cached_sector_next_used;
} FX_CACHED_SECTOR;
```

FX_MEDIA

```
typedef struct FX_MEDIA_STRUCT
{
    ULONG             fx_media_id;
    CHAR             *fx_media_name;
    UCHAR            *fx_media_memory_buffer;
    ULONG             fx_media_memory_size;
    UINT              fx_media_sector_cache_hashed;
    ULONG             fx_media_sector_cache_size;
    UCHAR            *fx_media_sector_cache_end;
    struct FX_CACHED_SECTOR_STRUCT
                     *fx_media_sector_cache_list_ptr;
    ULONG             fx_media_sector_cache_hashed_sector_valid;
    ULONG             fx_media_sector_cache_dirty_count;
    UINT              fx_media_bytes_per_sector;
    UINT              fx_media_sectors_per_track;
    UINT              fx_media_heads;
    ULONG64           fx_media_total_sectors;
    ULONG             fx_media_total_clusters;
#ifdef FX_ENABLE_EXFAT
    ULONG             fx_media_exfat_volume_serial_number;
    UINT              fx_media_exfat_file_system_revision;
    UINT              fx_media_exfat_volume_flag;
    USHORT            fx_media_exfat_drive_select;
    USHORT            fx_media_exfat_percent_in_use;
    UINT              fx_media_exfat_bytes_per_sector_shift;
    UINT              fx_media_exfat_sector_per_clusters_shift;
    UCHAR             fx_media_exfat_bitmap_cache[512];
    ULONG             fx_media_exfat_bitmap_start_sector;
    ULONG             fx_media_exfat_bitmap_cache_size_in_sectors;
    ULONG             fx_media_exfat_bitmap_cache_start_cluster;
    ULONG             fx_media_exfat_bitmap_cache_end_cluster;
    UINT              fx_media_exfat_bitmap_clusters_per_sector_shift;
    UINT              fx_media_exfat_bitmap_cache_dirty;
#endif
    UINT              fx_media_reserved_sectors;
    UINT              fx_media_root_sector_start;
    UINT              fx_media_root_sectors;
    UINT              fx_media_data_sector_start;
    UINT              fx_media_sectors_per_cluster;
    UINT              fx_media_sectors_per_FAT;
    UINT              fx_media_number_of_FATs;
    UINT              fx_media_12_bit_FAT;
    UINT              fx_media_32_bit_FAT;
    ULONG             fx_media_FAT32_additional_info_sector;
    UINT              fx_media_FAT32_additional_info_last_available;
#ifdef FX_DRIVER_USE_64BIT_LBA
    ULONG64           fx_media_hidden_sectors;
#else
    ULONG             fx_media_hidden_sectors;
#endif
    ULONG             fx_media_root_cluster_32;
    UINT              fx_media_root_directory_entries;
    ULONG             fx_media_available_clusters;
    ULONG             fx_media_cluster_search_start;
```

```
    VOID             *fx_media_driver_info;
    UINT              fx_media_driver_request;
    UINT              fx_media_driver_status;
    UCHAR            *fx_media_driver_buffer;
#ifdef FX_DRIVER_USE_64BIT_LBA
    ULONG64           fx_media_driver_logical_sector;
#else
    ULONG             fx_media_driver_logical_sector;
#endif
    ULONG             fx_media_driver_sectors;
    ULONG             fx_media_driver_physical_sector;
    UINT              fx_media_driver_physical_track;
    UINT              fx_media_driver_physical_head;
    UINT              fx_media_driver_write_protect;
    UINT              fx_media_driver_free_sector_update;
    UINT              fx_media_driver_system_write;
    UINT              fx_media_driver_data_sector_read;
    UINT              fx_media_driver_sector_type;
    VOID            (*fx_media_driver_entry)(struct FX_MEDIA_STRUCT *);
    VOID            (*fx_media_open_notify)(struct FX_MEDIA_STRUCT *);
    VOID            (*fx_media_close_notify)(struct FX_MEDIA_STRUCT *);
    struct FX_FILE_STRUCT
                     *fx_media_opened_file_list;
    ULONG             fx_media_opened_file_count;
    struct FX_MEDIA_STRUCT
                     *fx_media_opened_next,
                     *fx_media_opened_previous;
#ifndef FX_MEDIA_STATISTICS_DISABLE
    ULONG             fx_media_directory_attributes_reads;
    ULONG             fx_media_directory_attributes_sets;
    ULONG             fx_media_directory_creates;
    ULONG             fx_media_directory_default_gets;
    ULONG             fx_media_directory_default_sets;
    ULONG             fx_media_directory_deletes;
    ULONG             fx_media_directory_first_entry_finds;
    ULONG             fx_media_directory_first_full_entry_finds;
    ULONG             fx_media_directory_information_gets;
    ULONG             fx_media_directory_local_path_clears;
    ULONG             fx_media_directory_local_path_gets;
    ULONG             fx_media_directory_local_path_restores;
    ULONG             fx_media_directory_local_path_sets;
    ULONG             fx_media_directory_name_tests;
    ULONG             fx_media_directory_next_entry_finds;
    ULONG             fx_media_directory_next_full_entry_finds;
    ULONG             fx_media_directory_renames;
    ULONG             fx_media_file_allocates;
    ULONG             fx_media_file_attributes_reads;
    ULONG             fx_media_file_attributes_sets;
    ULONG             fx_media_file_best_effort_allocates;
    ULONG             fx_media_file_closes;
    ULONG             fx_media_file_creates;
    ULONG             fx_media_file_deletes;
    ULONG             fx_media_file_opens;
    ULONG             fx_media_file_reads;
    ULONG             fx_media_file_relative_seeks;
    ULONG             fx_media_file_renames;
    ULONG             fx_media_file_seeks;
    ULONG             fx_media_file_truncates;
    ULONG             fx_media_file_truncate_releases;
    ULONG             fx_media_file_writes;
    ULONG             fx_media_aborts;
    ULONG             fx_media_flushes;
    ULONG             fx_media_reads;
    ULONG             fx_media_writes;
    ULONG             fx_media_directory_entry_reads;
    ULONG             fx_media_directory_entry_writes;
    ULONG             fx_media_directory_searches;
    ULONG             fx_media_directory_free_searches;
    ULONG             fx_media_fat_entry_reads;
    ULONG             fx_media_fat_entry_writes;
```

```
    ULONG             fx_media_fat_entry_cache_read_hits;
    ULONG             fx_media_fat_entry_cache_read_misses;
    ULONG             fx_media_fat_entry_cache_write_hits;
    ULONG             fx_media_fat_entry_cache_write_misses;
    ULONG             fx_media_fat_cache_flushes;
    ULONG             fx_media_fat_sector_reads;
    ULONG             fx_media_fat_sector_writes;
    ULONG             fx_media_logical_sector_reads;
    ULONG             fx_media_logical_sector_writes;
    ULONG             fx_media_logical_sector_cache_read_hits;
    ULONG             fx_media_logical_sector_cache_read_misses;
    ULONG             fx_media_driver_read_requests;
    ULONG             fx_media_driver_write_requests;
    ULONG             fx_media_driver_boot_read_requests;
    ULONG             fx_media_driver_boot_write_requests;
    ULONG             fx_media_driver_release_sectors_requests;
    ULONG             fx_media_driver_flush_requests;
#ifndef FX_MEDIA_DISABLE_SEARCH_CACHE
    ULONG             fx_media_directory_search_cache_hits;
#endif
#endif
#ifndef FX_SINGLE_THREAD
    TX_MUTEX          fx_media_protect;
#endif

#ifndef FX_MEDIA_DISABLE_SEARCH_CACHE
    UINT              fx_media_last_found_directory_valid;
    FX_DIR_ENTRY      fx_media_last_found_directory;
    FX_DIR_ENTRY      fx_media_last_found_entry;
    CHAR              fx_media_last_found_file_name[FX_MAX_LONG_NAME_LEN];
    CHAR              fx_media_last_found_name[FX_MAX_LAST_NAME_LEN];
#endif
    FX_PATH           fx_media_default_path;
    FX_FAT_CACHE_ENTRY
                      fx_media_fat_cache[FX_MAX_FAT_CACHE];
    UCHAR             fx_media_fat_secondary_update_map[FX_FAT_MAP_SIZE];
    ULONG             fx_media_reserved_for_user;
    CHAR              fx_media_name_buffer[4*FX_MAX_LONG_NAME_LEN];
#ifdef FX_RENAME_PATH_INHERIT
    CHAR              fx_media_rename_buffer[FX_MAXIMUM_PATH];
    struct FX_CACHED_SECTOR_STRUCT
                      fx_media_sector_cache[FX_MAX_SECTOR_CACHE];
    ULONG             fx_media_sector_cache_hash_mask;
    ULONG             fx_media_disable_burst_cache;
#ifdef FX_ENABLE_FAULT_TOLERANT
    UCHAR             fx_media_fault_tolerant_enabled;
    UCHAR             fx_media_fault_tolerant_state;
    USHORT            fx_media_fault_tolerant_transaction_count;
    ULONG             fx_media_fault_tolerant_start_cluster;
    ULONG             fx_media_fault_tolerant_clusters;
    ULONG             fx_media_fault_tolerant_total_logs;
    UCHAR            *fx_media_fault_tolerant_memory_buffer;
    ULONG             fx_media_fault_tolerant_memory_buffer_size;
    ULONG             fx_media_fault_tolerant_file_size;
    ULONG             fx_media_fault_tolerant_cached_FAT_sector;
fx_media_fault_tolerant_cache[FX_FAULT_TOLERANT_CACHE_SIZE >> 2];
    ULONG             fx_media_fault_tolerant_cached_FAT_sector;
#endif
    ULONG             fx_media_fat_reserved;
    ULONG             fx_media_fat_last;
    UCHAR             fx_media_FAT_type;
} FX_MEDIA;
```

FX_FILE

```
typedef struct FX_FILE_STRUCT
{
    ULONG             fx_file_id;
    CHAR             *fx_file_name;
    ULONG             fx_file_open_mode;
    UCHAR             fx_file_modified;
    ULONG             fx_file_total_clusters;
    ULONG             fx_file_first_physical_cluster;
    ULONG             fx_file_consecutive_cluster;
    ULONG             fx_file_last_physical_cluster;
    ULONG             fx_file_current_physical_cluster;
    ULONG64           fx_file_current_logical_sector;
    ULONG             fx_file_current_logical_offset;
    ULONG             fx_file_current_relative_cluster;
    ULONG             fx_file_current_relative_sector;
    ULONG64           fx_file_current_file_offset;
    ULONG64           fx_file_current_file_size;
    ULONG64           fx_file_current_available_size;
#ifdef FX_ENABLE_FAULT_TOLERANT
    ULONG64           fx_file_maximum_size_used;
#endif /* FX_ENABLE_FAULT_TOLERANT */
    FX_MEDIA         *fx_file_media_ptr;
    struct FX_FILE_STRUCT
                     *fx_file_opened_next,
                     *fx_file_opened_previous;
    FX_DIR_ENTRY      fx_file_dir_entry;
    CHAR              fx_file_name_buffer[FX_MAX_LONG_NAME_LEN];
    ULONG             fx_file_disable_burst_cache;
    VOID             (*fx_file_write_notify)(struct FX_FILE_STRUCT *);
} FX_FILE;
```

Appendix D: ASCII Character Codes in HEX

ASCII Character Codes in HEX

more significant nibble

less significant nibble

<table>
<tr><th></th><th>0_</th><th>1_</th><th>2_</th><th>3_</th><th>4_</th><th>5_</th><th>6_</th><th>7_</th></tr>
<tr><td>_0</td><td>NUL</td><td>DLE</td><td>SP</td><td>0</td><td>@</td><td>P</td><td>'</td><td>p</td></tr>
<tr><td>_1</td><td>SOH</td><td>DC1</td><td>!</td><td>1</td><td>A</td><td>Q</td><td>a</td><td>q</td></tr>
<tr><td>_2</td><td>STX</td><td>DC2</td><td>"</td><td>2</td><td>B</td><td>R</td><td>b</td><td>r</td></tr>
<tr><td>_3</td><td>ETX</td><td>DC3</td><td>#</td><td>3</td><td>C</td><td>S</td><td>c</td><td>s</td></tr>
<tr><td>_4</td><td>EOT</td><td>DC4</td><td>$</td><td>4</td><td>D</td><td>T</td><td>d</td><td>t</td></tr>
<tr><td>_5</td><td>ENQ</td><td>NAK</td><td>%</td><td>5</td><td>E</td><td>U</td><td>e</td><td>u</td></tr>
<tr><td>_6</td><td>ACK</td><td>SYN</td><td>&</td><td>6</td><td>F</td><td>V</td><td>f</td><td>v</td></tr>
<tr><td>_7</td><td>BEL</td><td>ETB</td><td>'</td><td>7</td><td>G</td><td>W</td><td>g</td><td>w</td></tr>
<tr><td>_8</td><td>BS</td><td>CAN</td><td>(</td><td>8</td><td>H</td><td>X</td><td>h</td><td>x</td></tr>
<tr><td>_9</td><td>HT</td><td>EM</td><td>)</td><td>9</td><td>I</td><td>Y</td><td>i</td><td>y</td></tr>
<tr><td>_A</td><td>LF</td><td>SUB</td><td>*</td><td>:</td><td>J</td><td>Z</td><td>j</td><td>z</td></tr>
<tr><td>_B</td><td>VT</td><td>ESC</td><td>+</td><td>;</td><td>K</td><td>[</td><td>K</td><td>}</td></tr>
<tr><td>_C</td><td>FF</td><td>FS</td><td>,</td><td><</td><td>L</td><td>\</td><td>l</td><td>|</td></tr>
<tr><td>_D</td><td>CR</td><td>GS</td><td>-</td><td>=</td><td>M</td><td>]</td><td>m</td><td>}</td></tr>
<tr><td>_E</td><td>SO</td><td>RS</td><td>.</td><td>></td><td>N</td><td>^</td><td>n</td><td>~</td></tr>
<tr><td>_F</td><td>SI</td><td>US</td><td>/</td><td>?</td><td>O</td><td>_</td><td>o</td><td>DEL</td></tr>
</table>

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