Flash Objects

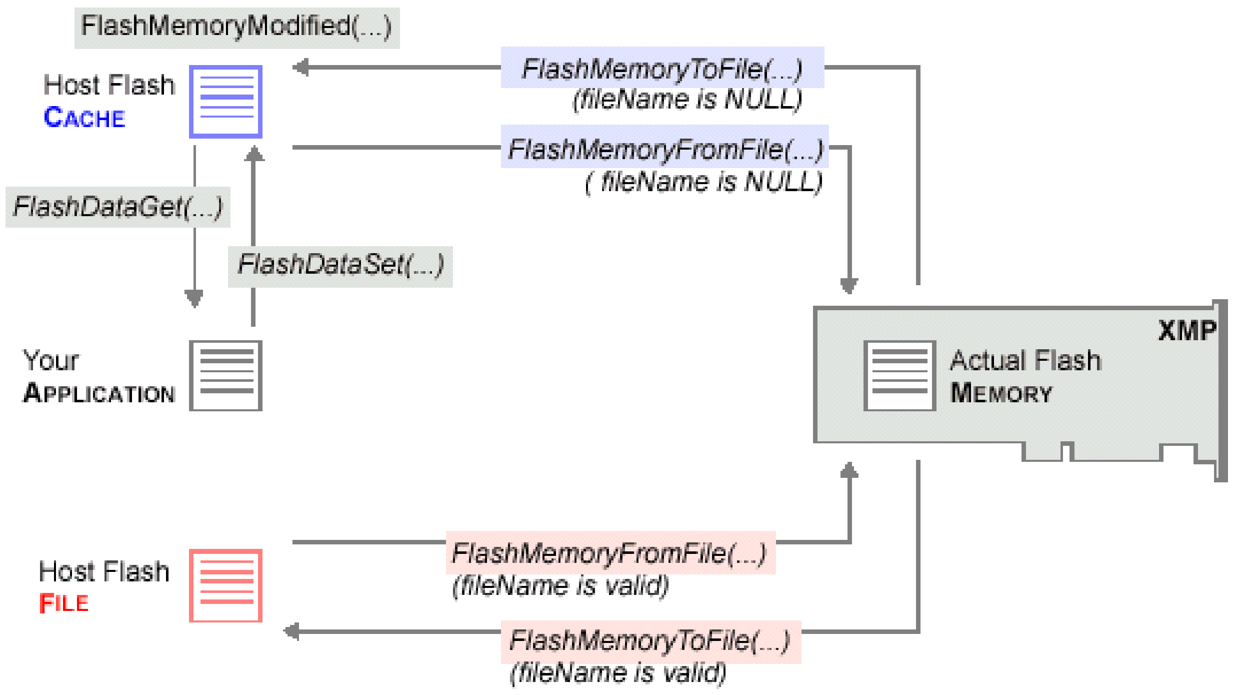
Introduction

A **Flash** object manages nonvolatile flash memory on the XMP/ZMP motion controllers. To optimize flash memory, a host-resident flash memory cache is used to provide faster writing performance.

After your application creates a Flash object (using meiFlashCreate(...)), the Flash object then creates a host-resident flash memory cache. meiFlashCreate(...) will create the flash object and initialize an internal (host-resident) cache with a copy of the flash on the board. All Flash functions (with the exception of meiFlashMemoryFromFile(...) will modify the host resident cache. When you have finished modifying the host resident cache, use meiFlasheMemoriyFromFile(fileName=NULL) to write the host cache data to the board's flash memory. meiFlashMemoryToFile(...) can be used to copy the board's flash to a user specified file. (If the filename is NULL, the data is copied to the host resident cache.) Host resident cache is deleted when meiFlashDelete(...) is called.

Use the meiFlashDataGet/Set(...) methods to move data between your application and the flash cache. Use the meiFlashMemoryToFile and meiFlashMemory/FromFile(...) methods to move data between the flash cache (or file) and the actual flash memory. Typically, your application would:

1. Create a Flash object [using **meiFlashCreate(...)**].
2. Pass the **MEIFlash** handle to the **FlashConfig[Get/Set](...)** methods of the objects to be configured (which in turn call the **meiFlashData[Get/Set](...)** methods).
3. Write the flash cache to actual flash memory [using **meiFlashMemoryFromFile(...)**].
4. Delete the Flash object.



Methods

Create, Delete, Validate Methods

meiFlash**Create**	Create Flash object
meiFlash**Delete**	Delete Flash object
meiFlash**Validate**	Validate Flash object

Configuration and Information Methods

meiFlash**ConfigGet**	Copy flash config from cache to application memory
meiFlash**ConfigSet**	Copy flash config from application memory to cache
meiFlash**DataGet**	Get count bytes of flash data memory and write them in application memory
meiFlash**DataSet**	Set count bytes of flash data memory using application memory

Memory Methods

meiFlash**MemoryFromFileImage**	
meiFlash**MemoryFromFileType**	Write actual flash memory using the binary image contained in filename
meiFlash**MemoryGet**	Copy count bytes of flash memory to application memory
meiFlash**MemoryModified**	Determine if flash cache has been modified
meiFlash**MemorySet**	Copy count bytes of application memory to flash memory
meiFlash**MemoryFromFile**	Write actual flash memory to cache or to file
meiFlash**MemoryToFile**	Save actual flash memory to cache or to file
meiFlash**MemoryVerify**	

Relational Methods

meiFlash**Control**	Return handle of Control that is associated with Flash

Data Types

MEIFlash**Config**

MEIFlash**FileMaxNameChars**

MEIFlash**FileMaxChars**

MEIFlash**FileMaxPathChars**

MEIFlash**Files**

MEIFlash**FileType**

MEIFlash**Message**

MEIFlash**Section**

meiFlashCreate

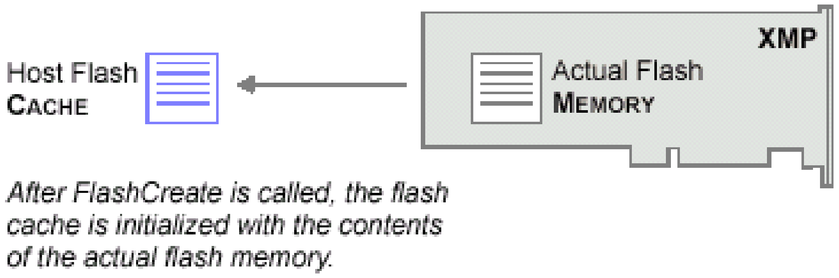
Declaration

```
MEIFlash meiFlashCreate(MPIControl control)
```

Required Header: stdmei.h

Description

meiFlashControl creates a Flash object and a host-resident copy of flash memory on motion controller ***control*** (called the flash cache). *FlashCreate* is the equivalent of a C++ constructor.


Host Flash Cache
XMP
Actual Flash Memory
After FlashCreate is called, the flash cache is initialized with the contents of the actual flash memory.

Return Values	
handle	to a Flash object
MPIHandleVOID	if the object could not be created

See Also

meiFlashDelete | meiFlashValidate

meiFlashDelete

Declaration

```
long meiFlashDelete(MEIFlash flash)
```

Required Header: stdmei.h

Description

meiFlashDelete deletes a Flash object and invalidates its handle (***flash***). *FlashDelete* is the equivalent of a C++ destructor.

Return Values	
MPIMessageOK	if *FlashDelete* successfully deletes a Flash object and invalidates its handle

See Also

meiFlashCreate | meiFlashValidate

meiFlashValidate

Declaration

```
long meiFlashValidate(MEIFlash flash)
```

Required Header: stdmei.h

Description

meiFlashValidate validates the Flash object and its handle (***flash***).

Return Values	
MPIMessageOK	if Flash is a handle to a valid object.

See Also

meiFlashCreate | meiFlashDelete

meiFlashConfigGet

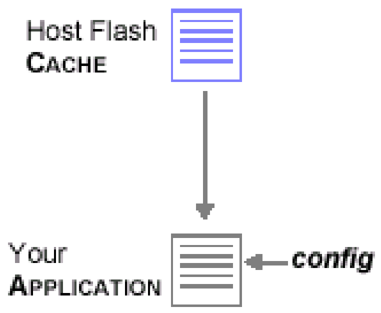
Declaration

```
long meiFlashConfigGet(MEIFlash       flash,
                       MEIFlashConfig *config)
```

Required Header: stdmei.h

Description

meiFlashConfigGet gets the flash configuration and writes it into the structure pointed to by ***config***. The flash configuration includes data about the actual flash memory device (its type and size).



Return Values	
MPIMessageOK	if *FlashConfigGet* successfully gets the flash configuration and writes it into the structure

See Also

meiFlashConfigSet

meiFlashConfigSet

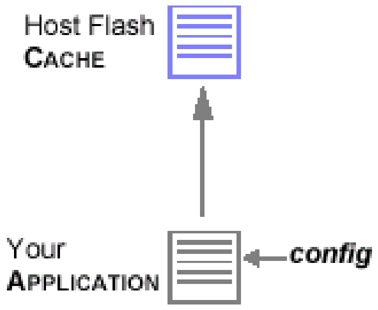
Declaration

```
long meiFlashConfigGet(MEIFlash       flash,
                       MEIFlashConfig *config)
```

Required Header: stdmei.h

Description

meiFlashConfigSet sets (reads) the control configuration from the structure pointed to by ***config***.



Return Values	
MPIMessageOK	if *FlashConfigSet* successfully reads the control configuration from the structure

See Also

meiFlashConfigGet

meiFlashDataGet

Declaration

```
long meiFlashDataGet(MEIFlash flash,
                     void     *dst,
                     void     *src,
                     long     count)
```

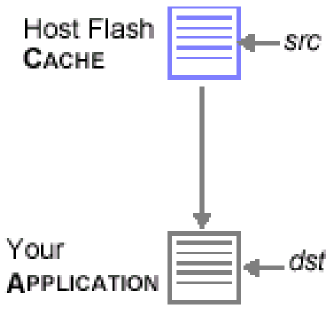
Required Header: stdmei.h

Description

meiFlashDataGet gets ***count*** bytes of ***flash*** data memory starting at address ***src*** and puts (writes) them in application memory starting at address ***dst***. The ***src*** pointer must point into the **MEIXmpData{...}** structure defined in *xmp.h* and be based on the firmware address (MEIXmpData *) returned by mpiControlMemory(...).

Your application cannot access Flash memory directly; instead your application will access the host-resident flash memory cache maintained by ***flash***.

meiFlashDataGet(...) reads from the flash cache and is called only by applications and utilities, while **meiFlashMemoryGet(...)** is a low-level method that reads directly from actual flash memory and is called primarily by other flash methods.



Return Values	
MPIMessageOK	if *FlashDataGet* successfully gets count bytes of flash data memory writes them to application memory

See Also

mpiControlMemory | meiFlashMemoryGet | meiFlashDataSet

meiFlashDataSet

Declaration

```
long meiFlashDataSet(MEIFlash flash,
                     void     *dst,
                     void     *src,
                     long     count)
```

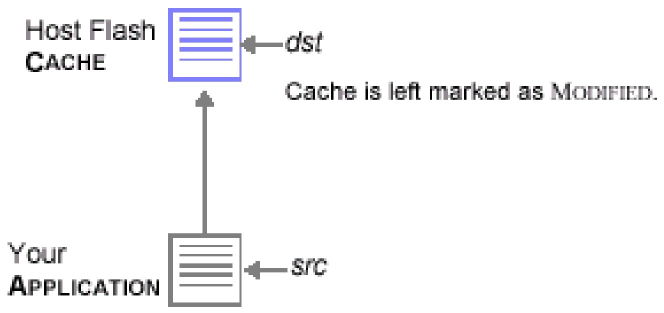
Required Header: stdmei.h

Description

meiFlashDataSet sets (writes) ***count*** bytes of ***flash*** data memory (starting at address ***dst***) using application memory (starting at address ***src***). The ***dst*** pointer must point into the **MEIXmpData{...}** structure defined in *xmp.h* and be based on the firmware address (MEIXmpData *) returned by mpiControlMemory(...).

Your application cannot access Flash memory directly; instead your application will access the host-resident flash memory cache maintained by flash.

mpiControlMemory(...) returns an external pointer that points to the MEIXmpBufferData{...} structure. You cannot use this external pointer with the FlashDataSet method to access flash data memory.



Return Values	
MPIMessageOK	if *FlashDataSet* successfully writes to the flash cache

See Also

mpiControlMemory | meiFlashDataGet

meiFlashMemoryFromFileImage

Declaration

```
long meiFlashMemoryFromFileImage(MEIFlash         flash,
                                 const char       *fileImage,
                                 MEIFlashFileType *fileType);
```

Required Header: stdmei.h

Description

meiFlashMemoryFromFileImage is used to erase and program controller flash memory. The values to be programmed are stored in the byte array fileImage. The parameter ***fileType*** is used by this method to determine the flash sector and size of the flash memory region to be programmed.

Supported values for ***fileType*** are:

- **MEIFlashFileTypeCode**, Code
- **MEIFlashFileTypeDataInt**, Internal Data
- **MEIFlashFileTypeDataExt**, External Data
- **MEIFlashFileTypeSynqNet**, SynqNet
- **MEIFlashFileTypeCodeAndData**, Code, Internal and External Data.
- **MEIFlashFileTypeFPGA0**, FPGA (Rincon)
- **MEIFlashFileTypeALL**, Code, Internal Data, External Data, and FPGA.

This method exists primarily for compatibility with older software. For new designs, it is recommeded that you use the the meiFlashMemoryFromFileType() method instead.

flash	a handle to a flash object
***fileImage**	a pointer to data in memory to be copied to flash.
***fileType**	where the fileImage will be copied to in flash.

Return Values	
MPIMessageOK	if *FlashMemoryFromFileImage* successfully erases/programs the controller flash memory.
MEIFlashMessageFLASH_INVALID	if the flash handle is invalid.
MPIMessageNO_MEMORY	the system could not allocate enough memory for temporary storage of the flash image.
MPIMessageTIMEOUT	the flash could not be programmed.
MEIFlashMessageFLASH_WRITE_ERROR	the programmed flash did not match the flash image in verfication.

See Also

meiFlashMemoryFromFileType

meiFlashMemoryFromFileType

Declaration

```
long meiFlashMemoryFromFileType(MEIFlash         flash,
                                const char       *fileName,
                                MEIFlashFileType fileType)
```

Required Header: stdmei.h

Description

meiFlashMemoryFromFileType writes actual flash memory using the binary image contained in ***fileName***, or using the flash memory cache.

flash	a handle to a Flash object
***filename**	a string
fileType	an enumeration corresponding to the flash file types

Return Values	
MPIMessageOK	if *FlashMemoryFromFileType* successfully copies the data from the file to the flash.

See Also

meiFlashCreate | meiFlashMemoryFromFile

meiFlashMemoryGet

Declaration

```
long meiFlashMemoryGet(MEIFlash flash,
                       void     *dst,
                       void     *src,
                       long     count)
```

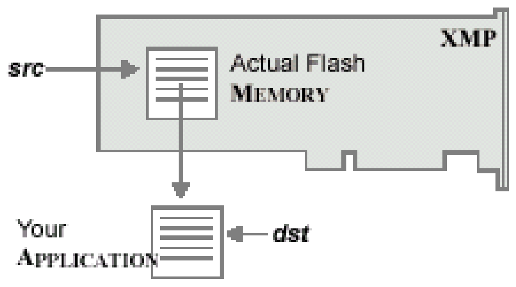
Required Header: stdmei.h

Description

meiFlashMemoryGet copies ***count*** bytes of actual flash memory (***flash***, starting at address ***src***) to application memory (starting at address ***dst***).

You should calculate the ***src*** pointer by considering flash memory as a stream of bytes, because FlashMemoryGet will adjust the pointer for the actual type of flash memory.

meiFlashMemoryGet(...) is a low-level method that reads directly from actual flash memory and is called primarily by other flash methods, while **meiFlashDataGet(...)** reads from the flash cache and is called only by applications and utilities.



Return Values	
MPIMessageOK	if *FlashMemoryGet* successfully copies flash memory to application memory

See Also

meiFlashMemorySet

meiFlashMemoryModified

Declaration

```
long meiFlashMemoryModified(MEIFlash flash,
                            long     *modified)
```

Required Header: stdmpi.h

Description

meiFlashMemoryModified determines if the flash memory cache has been modified. Note that unless meiFlashDataSet(...) has been called previously, the meiFlashMemoryModified(...) method will always return False, regardless of whether the cache has been modified or not modified.

If the "flash cache"	*Then*
has been modified	*FlashMemoryModified* writes True to the location pointed to by modified
has not been modified	*FlashMemoryModified* writes False to the location pointed to by modified

Return Values	
MPIMessageOK	if *FlashMemoryModified* successfully determines if the flash cache has been modified

See Also

meiFlashDataSet

meiFlashMemorySet

Declaration

```
long meiFlashMemorySet(MEIFlash flash,
                       void     *dst,
                       void     *src,
                       long     count)
```

Required Header: stdmei.h

Description

meiFlashMemorySet copies application memory (starting at address ***src***) to ***count*** bytes of flash memory (***flash***, starting at address ***dst***).

You should calculate the ***dst*** pointer by considering flash memory as a stream of bytes, because FlashMemoryGet will adjust the pointer for the actual type of flash memory.

Remarks

flash memory is of type *unsigned long* *.

Return Values	
MPIMessageOK	if *FlashMemorySet* successfully copies application memory to flash memory

See Also

meiFlashMemoryGet

meiFlashMemoryFromFile

Declaration

```
long meiFlashMemoryFromFile(MEIFlash      flash,
                            MEIFlashFiles *filesIn,
                            MEIFlashFiles *filesOut);
```

Required Header: stdmei.h

Description

meiFlashMemoryFromFile reads the filenames pointed to by ***filesIn*** and copies the binary images into the controller's flash memory. The array of structures pointed to by ***filesOut*** is filled in with the names of the files that were successfully copied into the controller's flash memory. After the next power cycle or mpiControlReset(.) the controller will load the flash images into the local processor and FPGA(s).

flash	a handle to a flash object
***filesIn**	a pointer to an array of flash filename structures to download to the controller. See MEIFlashFiles.
***filesOut**	a pointer to an array of flash filename structures that were successfully downloaded to the controller. See MEIFlashFiles.

Return Values	
MPIMessageOK	if *FlashMemoryFromFile* successfully writes to actual flash memory using the file or using flash cache.

See Also

MEIFlashFiles | mpiControlReset

meiFlashMemoryToFile

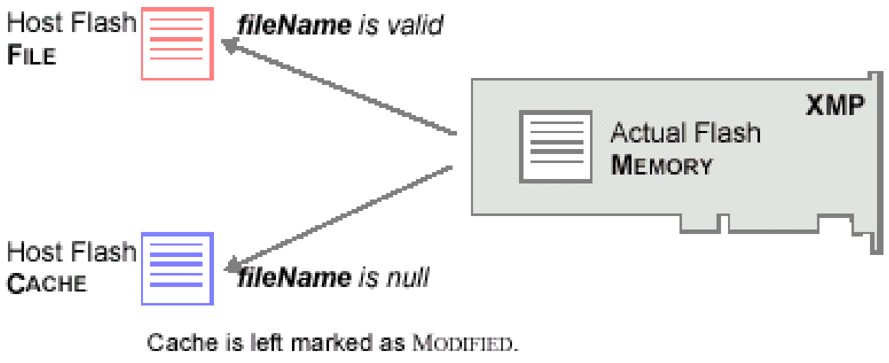
Declaration

```
long meiFlashMemoryToFile(MEIFlash         flash,
                          const char       *fileName,
                          MEIFlashFileType fileType)
```

Required Header: stdmei.h

Description

meiFlashMemoryToFile saves actual ***flash*** memory to a binary image contained in ***fileName***, or to the flash memory cache.



Return Values	
MPIMessageOK	if *FlashMemoryToFile* successfully saves actual flash memory to file or to cache

See Also

meiFlashMemoryVerify

Declaration

```
long meiFlashMemoryVerify(MEIFlash          flash,
                          const char        *fileName,
                          MEIFlashFileType  fileType);
```

Required Header: stdmei.h

Description

meiFlashMemoryVerify is function that verifies Flash memory against an input file. It takes a flash object, the filename of the input file, and a file type.

The ***fileType*** is used to tell the function what part of flash memory to verify (Code space, data space, both, etc. see MEIFlashFileType enum in flash.h).

NOTE: meiFlashMemoryVerify has been added back to the MPI in order to allow customers who wish to verify that the file loaded in flash is the same as the default file.

flash	a handle to a Flash object
***filename**	a string
fileType	an enumeration corresponding to the flash file types

Return Values	
MPIMessageOK	if *FlashMemoryVerify* successfully verifies the Flash memory against an input file.
MEIFlashMessageFLASH_READ_ERROR	if the input file does not match what is in flash memory.

See Also

meiFlashControl

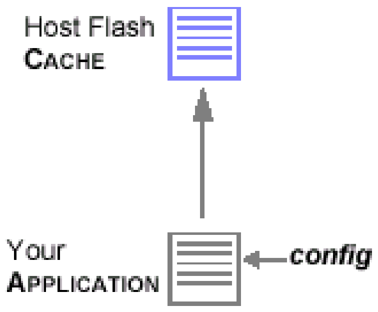
Declaration

```
MPIControl meiFlashControl(MEIFlash flash)
```

Required Header: stdmei.h

Description

meiFlashControl returns a handle to the motion controller (Control object) that a Flash object (***flash***) is associated with.



Return Values	
handle	to a Control object that a Flash object is associated with
MPIHandleVOID	if the Flash object is invalid

See Also

MEIFlashConfig

Definition

```
typedef struct MEIFlashConfig {
    long                   wordSize;
    long                   sectorSize;
    long                   extMemSize;
    MEIFlashSection    all;
    MEIFlashSection    code;
    MEIFlashSection    codeBoot0;
    MEIFlashSection    codeBoot;
    MEIFlashSection    codeMain;
    MEIFlashSection    data;
    MEIFlashSection    dataExt;
    MEIFlashSection    synqNet;
    MEIFlashSection    FPGA0;
} MEIFlashConfig;
```

Description

The **MEIFlashConfig** structure contains the flash configuration parameters. This data is stored in the host's memory and is internally used by the MPI library to manage flash reads/writes. Typically, applications do not need to access the flash configurations.

WARNING:
This data structure is for MEI internal purposes only and should not be configured by a customer.

wordSize	The size of a flash word in bytes.
sectorSize	The size of a flash sector in bytes.
extMemSize	The size of the controller's external memory in bytes.
all	The flash section parameters for the controller's code, data, and local FPGA images.
code	The flash section parameters for the controller's boot and main code.
codeBoot0	The flash section parameters for the controller's boot and main code. (ZMP)
codeBoot	The flash section parameters for the controller's boot code.
codeMain	The flash section parameters for the controller's main code.

data	The flash section parameters for the controller's internal data memory.
dataExt	The flash section parameters for the controller's external data memory.
synqNet	This is for the controller's synqnet data memory.
FPGA0	The flash section parameters for the local FPGA image number 0.

See Also

MEIFlashSection | MEIFlashFileType | meiFlashConfigGet | meiFlashConfigSet

MEIFlashFileMaxNameChars

Definition

```
#define MEIFlashFileMaxNameChars   (12)  /*8.3 format */
```

Description

The **MEIFlashFileMaxNameChars** define is used internally by the MPI when linking a series of strings to create the full path name of the flash file. If the user tries to use a file with more than 12 characters (8.3 format), then the MPI will not be able to create the correct filename and may result in problems when opening the file.

See Also

MEIFlashFileMaxChars | MEIFlashFileMaxPathChars

MEIFlashFileMaxChars

Definition

```
#define MEIFlashFileMaxChars   (120)
```

Description

The MPI has to create filenames with the full path in order to open the flash files. **MEIFlashFileMaxChars** is an arbitrary size that is used by the MPI to allocate memory space for the filename. Full path filenames should not exceed 120 characters.

See Also

MEIFlashFileMaxNameChars | MEIFlashFileMaxPathChars

MEIFlashFileMaxPathChars

Definition

```
#define MEIFlashFileMaxPathChars (MEIFlashFileMaxChars -
                                  MEIFlashFileMaxNameChars)
```

Description

MEIFlashFileMaxPathChars is used internally by the MPI when creating full path filenames. This is the number of characters available for the path, not including the actual filename.

See Also

MEIFlashFileMaxNameChars | MEIFlashFileMaxChars

MEIFlashFiles

Definition

```
typedef struct MEIFlashFiles {
    char binFile [MEIFlashFileMaxChars];
    char FPGAFile[MEIXmpFlashMaxFPGAFiles][MEIFlashFileMaxChars];
} MEIFlashFiles;
```

Description

The **MEIFlashFiles** structure specifies the binary files to be downloaded to the controller.

WARNING:
This data structure is for MEI internal purposes only and should not be configured by a customer.

binFile	A controller firmware filename. The firmware file contains configuration data and executable code. The firmware file format is binary.
FPGAFile	An array of FPGA filenames. The FPGA file contains the binary image that is loaded into the FPGA component. Only the appropriate FPGA file can be loaded.

See Also

meiFlashMemoryFromFile

MEIFlashFileType

Definition

```
typedef enum {
    MEIFlashFileTypeNONE = 0,
    MEIFlashFileTypeCode,
    MEIFlashFileTypeDataInt,
    MEIFlashFileTypeDataExt,
    MEIFlashFileTypeSynqNet,
    MEIFlashFileTypeCodeAndData,
    MEIFlashFileTypeFPGA0,
    MEIFlashFileTypeALL    /* Loads Code and all FPGAs
                              (for .bin files that include
                              the FPGA images) */
} MEIFlashFileType;
```

Description

MEIFlashFileType is an enumeration of file types. Each file type contains code or data for the controller's flash memory. This enumeration is used to specify what code/data is to be copied to flash memory with meiFlashMemoryFromFileType(...) or copied from flash memory with meiFlashMemoryToFile(...).

MEIFlashFileTypeCode	Controller processor code only.
MEIFlashFileTypeDataInt	Controller internal data only.
MEIFlashFileTypeDataExt	Controller external data only.
MEIFlashFileTypeSynqNet	Used for flashing the synqNet page of flash.
MEIFlashFileTypeCodeAndData	Controller processor code and data.
MEIFlashFileTypeFPGA0	Local FPGA image number 0.
MEIFlashFileTypeALL	All code, data, and FPGA images.

See Also

meiFlashMemoryFromFileType | meiFlashMemoryToFile | meiFlashMemoryVerify

MEIFlashMessage

Definition

```
typedef enum {

   MEIFlashMessageFLASH_INVALID,
   MEIFlashMessageFLASH_VERIFY_ERROR,
   MEIFlashMessageFLASH_WRITE_ERROR,
   MEIFlashMessagePATH,
   MEIFlashMessageNETWORK_TOPOLOGY_ERROR,
} MEIFlashMessage;
```

Description

MEIFlashMessage lists the error messages returned by the MEIFlash module.

MEIFlashMessageFLASH_INVALID

The flash object is not valid. This message code is returned by meiFlashMemoryFromFile(.), meiFlashMemoryFromFileType(.), meiFlashMemoryToFile(.), or meiFlashMemoryVerify(.) if the flash object's memory cache has not been allocated. The flash memory cache is allocated in mpiFlashCreate(.). To prevent this problem, create flash objects with mpiFlashCreate(.) and check the return value.

MEIFlashMessageFLASH_VERIFY_ERROR

The flash memory verify failed. This message code is returned by meiFlashMemoryVerify(.) if the read from flash memory does not match the read from the file. This indicates that the specified flash file is different from the flash memory. This message code can also be returned from meiFlashMemoryFromFile(.), since it calls meiFlashMemoryVerify(.). To correct this problem, first check that the specified file is the one you intended. If the specified file is correct, use meiFlashMemoryFromFile(.) to download the file.

MEIFlashMessageFLASH_WRITE_ERROR

The flash memory write failed. This message code is returned by meiFlashMemoryFromFile(.) or meiFlashMemoryFromFileType(.) if the flash memory write fails. This indicates a problem in the flash memory component or subsystem.

MEIFlashMessagePATH

The flash file path is too long. This message code is returned by meiFlashMemoryFromFile(.) if the file path is longer than MEIFlashFileMaxPathChars. To correct this problem, use a shorter path.

MEIFlashMessageNETWORK_TOPOLOGY_ERROR

The network topology has not been saved to flash. This message code is returned by object flash config set methods if the network topology has not been previously saved to flash. This message code serves as a warning of a potential safety problem. Saving object configurations to flash will cause those values to be sent to nodes during the next network intialization, even if the flash configurations are not compatible with the network topology. If the network topology is saved to flash, then the controller will automatically verify the topology before sending object configuration values to the nodes.

See Also

MEIFlash

MEIFlashSection

Definition

```
typedef struct MEIFlashSection {
    unsigned char   *address;
    long            size;
    long            sectorIndex;
} MEIFlashSection;
```

Description

The **MEIFlashSection** structure contains the flash configuration parameters for a specified section.

***address**	A pointer to a flash sector address.
size	Length of the flash memory in bytes.
sectorIndex	The flash sector number.

See Also

MEIFlashConfig | meiFlashConfigGet | meiFlashConfigSet