

CDF

C# Reference Manual

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Chapter 1

1 Compiling

C#-CDF distribution is packaged in a self-extracting installer. Once the installer is downloaded and run, all distributed files, i.e., APIs, test programs, batch files, help information and the document, will be placed into a directory of choice, and environment variables, **PATH** and **CsharpCDFDir**, are automatically set. If an older version already exists in the host machine, the installer will try to remove it before the new one is installed.

To C#, CDF library is unmanaged code distributed in the native DLL. The distributed .DLLs were built from a 32-bit (x86) Windows and they can be run on a 32-bit Windows via the x86-compatible Common Language Runtime (CLR), as well as a 64-bit Windows under WOW64.

1.1 Namespaces

Several classes are created for C# applications that facilitate the calls to the native **CDF .DLL**. The **CDF namespace** has been set up to include these CDF related classes: **CDFConstants**, **CDFException**, **CDFAPIs**. and **CDFUtils**. **CDFConstants** provides commonly used constants that mimic to those defined in the .DLL **CDFException** provides the exception handling when a failed CDF operation is detected. **CDFAPIs** provide all (static) public (and private) methods that C# applications can call to interact with the similar, underlining functions provided by the CDF Standard Interface in the .DLL. **CDFUtils** provides several small utility tools. These classes are distributed in the form of **signed assemblies**, as **.DLLs**. To facilitate the access to functions in DLL, each C# application must use the “**cdf**” namespace in order to call the C#-CDF APIs. The following namespaces should be included by C# applications that call CDF APIs:

```
using System;  
using System.Runtime.InteropServices;  
using CDF;
```

1.2 Base Classes

CDFAPIs is the main class that provides the C#-CDF APIs. Class **CDFAPIs** inherits from **CDFConstants** class, which defines all constants referenced by the CDF. A C# application, if inheriting from the **CDFAPIs** class, can call all **CDFAPIs** methods and refer **CDFConstants**' constants directly, without specifying their class names. **CDFException** class inherits from C#'s **Exception** class and **CDFUtils** class inherits from **CDFConstants** class as well, .

1.3 Compiling with Compiler Options

If a test application, e.g., TestCDF.cs, resides in the same directory as all distributed .dll files, the following command can be used to create an executable

```
csc /unsafe /platform:x86 /r:CDFAPIs.dll,CDFException.dll,  
CDFConstants.dll,CDFUtils.dll TestCDF.cs
```

csc.exe, the C# compiler, can be called automatically from an IDE such as Visual Studio .NET, or run from the command line if the PATH environment variable is set properly. csc.exe can be found in the **Windows's .NET Framework** directory, <windows>\Microsoft.NET\Framework\v#. # (v#. # as v3.5 or in the latest release version).

/unsafe option is required as pointers are used by C# applications to communicate with the CDF APIs and .DLL.
/platform:x86 option is required for the Windows running 64-bit OS as C#-CDF is built on an **x86** (32-bit) platform.

When the C#-CDF package is installed, the **PATH** environment variable is automatically modified to include the installation directory so the native CDF .DLL, **dllcdfsharp.dll**, becomes available when a C# application calls CDF functions. Once the executable, TestCDF.exe, is created, it can be run from any directory.

If the C# applications that call CDF APIs reside in the directories other than the C#-CDF installation directory, the following compilation command can be used to create an executable (.exe):

```
csc /unsafe /platform:x86  
/lib:%CsharpCDFDir%  
/r:cdfapis.dll,cdfconstants.dll,cdfexception.dll,cdfutils.dll  
TestCDF.cs
```

where environment variable CsharpCDFDir, the installation directory for C#-CDF package, .is set when the installer is run.

When the executable is run, an exception of "**FileNotFoundException**" will be encountered as CDFAPIs could not be loaded. It's because the distributed CDF assemblies are considered **private** in the .NET environment. The .NET Framework's runtime, **Common Language Runtime (CLR)**, will not be able to locate the files if the application resides in a different directory from the called assemblies. To make these assemblies **global** so CLR can locate, they need to be placed in the **Global Assembly Cache (GAC)** repository. Use the following steps to do so:

```
gacutil /i CDFConstants.dll  
gacutil /i CDFException.dll  
gacutil /i CDFAPIs.dll  
gacutil /i CDFUtils.dll
```

gacutil.exe (Global Assembly Cache utility) is a **Microsoft Software Development Kits (SDKs)** utility that can insert, list and remove the assemblies to and from GAC. Gacutil.exe usually can be found at <Program Files>\Microsoft SDKs\Windows\v#. #\bin (v#. # as v6.0A or in the latest release version). Use "gacutil /u" to remove assemblies of older versions from GAC.

ildasm.exe is another SDKs utility that can be used to browse the assemblies for information as versions, keys, etc..

1.4 Sample programs

Several sample programs are included for distribution. **Qst2cs.cs** and **Qst2cs2.cs**, two quick test programs for C#, are similar and call the same APIs. The only significant difference between them is they use different overloaded methods when calling the same APIs: **Qst2cs** uses **pointers arguments**, if possible, while **Qst2cs2** passes the base class **objects** for arguments, instead. Tests show that **Qst2cs** runs faster than **Qst2cs2**. **Qts2cEpoch.cs** and **Qst2cEpoch16.cs** are two sample programs that show how EPOCH-related functions are used. A batch file, **tocompile.bat**, is distributed along with the sample programs. Execute it from a Command Prompt window to compile the programs into executables (**.exe**). Run **totest.bat** to test the executables to make sure they all work fine.

Chapter 2

2 Programming Interface

2.1 Item Referencing

The following sections describe various aspects of the programming interface for C# applications.

For C# applications, all item numbers are referenced starting at zero (0). These include variable, attribute, and attribute entry numbers, record numbers, dimensions, and dimension indices. Note that both rVariables and zVariables are numbered starting at zero (0).

2.2 Compatible Types

As C# and CDF .DLL may have different sizes of the same data types, e.g. long, the size compatibility must be enforced when passing the data between the two. On 32-bit Windows, **4-byte long** has been used all over in the CDF .DLL. However, long in C# is defined as **8-byte**. So, to make the size compatible, 4-byte **int** is used, instead, in C# for each long type variable in the .DLL. For CDF data of CDF_CHAR, or CDF_UCHAR type, it is represented by a string in C#. They are not size compatible, so conversion, performed in the APIs, is needed between a character array in .DLL and string in C#.

The C#-CDF operations normally involve two variables: the operation status, status, and the CDF identifier, id:

status	All C#-CDF functions, except CDFvarNum, CDFgetVarNum, CDFattrNum and CDFgetAttrNum, return an operation status. This status is defined as an int in .DLL and C#. The CDFerror method can be used to inquire the meaning of any status code. Appendix A lists the possible status codes along with their explanations. Chapter 5 describes how to interpret status codes.
id	An identifier (or handle) for a CDF that must be used when referring to a CDF. This identifier has a type of void* in .DLL and C#. A new void* is established whenever a CDF is created or opened, establishing a connection to that CDF on disk. The void* is used in all subsequent operations on a particular CDF. The void* must not be altered by an application. With this pointer, C# applications are always declared as “ unsafe ”.

2.3 CDFConstants

CDF defines a set of constants that are used all over the .DLL. These constants are mimicked in CDFConstants class with compatible data types.

2.4 CDF status

These constants are of same type as the operation status, mentioned in 2.2.

CDF_OK	A status code indicating the normal completion of a CDF function.
CDF_WARN	Threshold constant for testing severity of non-normal CDF status codes.

Status less than CDF_OK normally indicate an error. For most cases, an exception will be thrown.

2.5 CDF Formats

SINGLE_FILE	The CDF consists of only one file. This is the default file format.
MULTI_FILE	The CDF consists of one header file for control and attribute data and one additional file for each variable in the CDF.

2.6 CDF Data Types

One of the following constants must be used when specifying a CDF data type for an attribute entry or variable.

CDF_BYTE	1-byte, signed integer.
CDF_CHAR	1-byte, signed character.
CDF_INT1	1-byte, signed integer.
CDF_UCHAR	1-byte, unsigned character.
CDF_UINT1	1-byte, unsigned integer.
CDF_INT2	2-byte, signed integer.
CDF_UINT2	2-byte, unsigned integer.

CDF_INT4	4-byte, signed integer.
CDF_UINT4	4-byte, unsigned integer.
CDF_INT8	8-byte, signed integer.
CDF_REAL4	4-byte, floating point.
CDF_FLOAT	4-byte, floating point.
CDF_REAL8	8-byte, floating point.
CDF_DOUBLE	8-byte, floating point.
CDF_EPOCH ¹	8-byte, floating point.
CDF_EPOCH16	two 8-byte, floating point.
CDF_TIME_TT2000 ²	8-byte, signed integer.

The following table depicts the equivalent data type between the CDF and C#:

<u>CDF Data Type</u>	<u>C# Data Type</u>
CDF_BYTE	sbyte
CDF_INT1	sbyte
CDF_UINT1	byte
CDF_INT2	short
CDF_UINT2	ushort
CDF_INT4	int
CDF_UINT4	uint
CDF_INT8	long
CDF_REAL4	float
CDF_FLOAT	float
CDF_REAL8	double
CDF_DOUBLE	double
CDF_EPOCH	double
CDF_EPOCH16	double[] ³
CDF_TIME_TT2000	long
CDF_CHAR	string
CDF_UCHAR	string

CDF_CHAR and CDF_UCHAR are considered character data types. These are significant because only variables of these data types may have more than one element per value (representing the length of the string, where each element is a character).

NOTE: Keep in mind that an long is 8 bytes and that an int is 4 bytes. Use int for CDF data types CDF_INT4 and CDF_UINT4, rather than long. Use long for CDF_INT8 and CDF_TIME_TT2000 data types.

¹ CDF_EPOCH, a double value, with milliseconds since 0000-01-01T00.00.000 as its integer portion and sub-milliseconds at fraction portion. Currently, methods, e.g., breakdown, encode, etc, only handle integer portion.

² CDF_TIME_TT2000, a long value, with nanoseconds since J2000.

³ CDF_EPOCH16 has two doubles, which corresponds to an array as double[] in C#.

2.7 Data Encodings

A CDF's data encoding affects how its attribute entry and variable data values are stored (on disk). Attribute entry and variable values passed into the CDF library (to be written to a CDF) should always be in the host machine's native encoding. Attribute entry and variable values read from a CDF by the CDF library and passed out to an application will be in the currently selected decoding for that CDF (see the Concepts chapter in the CDF User's Guide).

HOST_ENCODING	Indicates host machine data representation (native). This is the default encoding, and it will provide the greatest performance when reading/writing on a machine of the same type.
NETWORK_ENCODING	Indicates network transportable data representation (XDR).
VAX_ENCODING	Indicates VAX data representation. Double-precision floating-point values are encoded in Digital's D_FLOAT representation.
ALPHAVMSd_ENCODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's D_FLOAT representation.
ALPHAVMSg_ENCODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's G_FLOAT representation.
ALPHAVMSi_ENCODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values are encoded in IEEE representation.
ALPHAOSF1_ENCODING	Indicates DEC Alpha running OSF/1 data representation.
SUN_ENCODING	Indicates SUN data representation.
SGi_ENCODING	Indicates Silicon Graphics Iris and Power Series data representation.
DECSTATION_ENCODING	Indicates DECstation data representation.
IBMRS_ENCODING	Indicates IBMRS data representation (IBM RS6000 series).
HP_ENCODING	Indicates HP data representation (HP 9000 series).
IBMPC_ENCODING	Indicates Intel i386 data representation.
NeXT_ENCODING	Indicates NeXT data representation.
MAC_ENCODING	Indicates Macintosh data representation.
ARM_LITTLE_ENCODING	Indicates ARM architecture running little-endian data representation.
ARM_BIG_ENCODING	Indicates ARM architecture running big-endian data representation.
IA64VMSi_ENCODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in IEEE representation.

IA64VMSd_ENCODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's D_FLOAT representation.
IA64VMSg_ENCODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's G_FLOAT representation.

When creating a CDF (via CDFcreate) or respecifying a CDF's encoding (via CDFsetEncoding), you may specify any of the encodings listed above. Specifying the host machine's encoding explicitly has the same effect as specifying HOST_ENCODING.

When inquiring the encoding of a CDF, either NETWORK_ENCODING or a specific machine encoding will be returned. (HOST_ENCODING is never returned.)

2.8 Data Decodings

A CDF's decoding affects how its attribute entry and variable data values are passed out to a calling application. The decoding for a CDF may be selected and reselected any number of times while the CDF is open. Selecting a decoding does not affect how the values are stored in the CDF file(s) - only how the values are decoded by the CDF library. Any decoding may be used with any of the supported encodings. The Concepts chapter in the CDF User's Guide describes a CDF's decoding in more detail.

HOST_DECODING	Indicates host machine data representation (native). This is the default decoding.
NETWORK_DECODING	Indicates network transportable data representation (XDR).
VAX_DECODING	Indicates VAX data representation. Double-precision floating-point values will be in Digital's D_FLOAT representation.
ALPHAVMSd_DECODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values will be in Digital's D_FLOAT representation.
ALPHAVMSg_DECODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values will be in Digital's G_FLOAT representation.
ALPHAVMSi_DECODING	Indicates DEC Alpha running OpenVMS data representation. Double-precision floating-point values will be in IEEE representation.
ALPHAOSF1_DECODING	Indicates DEC Alpha running OSF/1 data representation.
SUN_DECODING	Indicates SUN data representation.
SGi_DECODING	Indicates Silicon Graphics Iris and Power Series data representation.
DECSTATION_DECODING	Indicates DECstation data representation.
IBMRS_DECODING	Indicates IBMRS data representation (IBM RS6000 series).

HP_DECODING	Indicates HP data representation (HP 9000 series).
IBMPC_DECODING	Indicates Intel i386 data representation.
NeXT_DECODING	Indicates NeXT data representation.
MAC_DECODING	Indicates Macintosh data representation.
ARM_LITTLE_DECODING	Indicates ARM architecture running little-endian data representation.
ARM_BIG_DECODING	Indicates ARM architecture running big-endian data representation.
IA64VMSi_DECODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in IEEE representation.
IA64VMSd_DECODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's D_FLOAT representation.
IA64VMSg_DECODING	Indicates Itanium 64 running OpenVMS data representation. Double-precision floating-point values are encoded in Digital's G_FLOAT representation.

The default decoding is HOST_DECODING. The other decodings may be selected via the CDFsetDecoding method. The Concepts chapter in the CDF User's Guide describes those situations in which a decoding other than HOST_DECODING may be desired.

2.9 Variable Majorities

A CDF's variable majority determines the order in which variable values (within the variable arrays) are stored in the CDF file(s). The majority is the same for rVariables and zVariables.

ROW_MAJOR	C-like array ordering for variable storage. The first dimension in each variable array varies the slowest. This is the default.
COLUMN_MAJOR	Fortran-like array ordering for variable storage. The first dimension in each variable array varies the fastest.

Knowing the majority of a CDF's variables is necessary when performing hyper reads and writes. During a hyper read the CDF library will place the variable data values into the memory buffer in the same majority as that of the variables. The buffer must then be processed according to that majority. Likewise, during a hyper write, the CDF library will expect to find the variable data values in the memory buffer in the same majority as that of the variables.

The majority must also be considered when performing sequential reads and writes. When sequentially reading a variable, the values passed out by the CDF library will be ordered according to the majority. When sequentially writing a variable, the values passed into the CDF library are assumed (by the CDF library) to be ordered according to the majority.

As with hyper reads and writes, the majority of a CDF's variables affect multiple variable reads and writes. When performing a multiple variable write, the full-physical records in the buffer passed to the CDF library must have the

CDF's variable majority. Likewise, the full-physical records placed in the buffer by the CDF library during a multiple variable read will be in the CDF's variable majority.

For C applications the compiler-defined majority for arrays is row major. The first dimension of multi-dimensional arrays varies the slowest in memory.

2.10 Record/Dimension Variances

Record and dimension variances affect how variable data values are physically stored.

VARY True record or dimension variance.

NOVARY False record or dimension variance.

If a variable has a record variance of VARY, then each record for that variable is physically stored. If the record variance is NOVARY, then only one record is physically stored. (All of the other records are virtual and contain the same values.)

If a variable has a dimension variance of VARY, then each value/subarray along that dimension is physically stored. If the dimension variance is NOVARY, then only one value/subarray along that dimension is physically stored. (All other values/subarrays along that dimension are virtual and contain the same values.)

2.11 Compressions

The following types of compression for CDFs and variables are supported. For each, the required parameters are also listed. The Concepts chapter in the CDF User's Guide describes how to select the best compression type/parameters for a particular data set. Among the available types, GZIP provides the best result.

NO_COMPRESSION No compression.

RLE_COMPRESSION Run-length encoding compression. There is one parameter.

1. The style of run-length encoding. Currently, only the run-length encoding of zeros is supported. This parameter must be set to RLE_OF_ZEROS.

HUFF_COMPRESSION Huffman compression. There is one parameter.

1. The style of Huffman encoding. Currently, only optimal encoding trees are supported. An optimal encoding tree is determined for each block of bytes being compressed. This parameter must be set to OPTIMAL_ENCODING_TREES.

AHUFF_COMPRESSION Adaptive Huffman compression. There is one parameter.

1. The style of adaptive Huffman encoding. Currently, only optimal encoding trees are supported. An optimal encoding tree is determined for each block of bytes being compressed. This parameter must be set to OPTIMAL_ENCODING_TREES.

GZIP_COMPRESSION

Gnu's "zip" compression.⁴ There is one parameter.

1. The level of compression. This may range from 1 to 9. 1 provides the least compression and requires less execution time. 9 provide the most compression but require the most execution time. Values in-between provide varying compromises of these two extremes. 6 normally provides a better balance between compression rate and execution.

2.12 Sparseness

2.12.1 Sparse Records

The following types of sparse records for variables are supported.

NO_SPARSERECORDS

No sparse records.

PAD_SPARSERECORDS

Sparse records - the variable's pad value is used when reading values from a missing record.

PREV_SPARSERECORDS

Sparse records - values from the previous existing record are used when reading values from a missing record. If there is no previous existing record the variable's pad value is used.

2.12.2 Sparse Arrays

The following types of sparse arrays for variables are supported by VFG.⁵

NO_SPARSEARRAYS

No sparse arrays.

Note: sparse array is not supported and will not be implmeneted.

2.13 Attribute Scopes

Attribute scopes are simply a way to explicitly declare the intended use of an attribute by user applications (and the CDF toolkit).

GLOBAL_SCOPE

Indicates that an attribute's scope is global (applies to the CDF as a whole).

VARIABLE_SCOPE

Indicates that an attribute's scope is by variable. (Each rEntry or zEntry corresponds to an rVariable or zVariable, respectively.)

⁴ Disabled for PC running 16-bit DOS/Windows 3.x.

⁵ The sparse arrays are not (and will not be) supported.

2.14 Read-Only Modes

Once a CDF has been opened, it may be placed into a read-only mode to prevent accidental modification (such as when the CDF is simply being browsed). Read-only mode is selected via `CDFsetReadOnlyMode` method. When read-only mode is set, all metadata is read into memory for future reference. This improves overall metadata access performance but is extra overhead if metadata is not needed. Note that if the CDF is modified while not in read-only mode, subsequently setting read-only mode in the same session will not prevent future modifications to the CDF.

<code>READONLYon</code>	Turns on read-only mode.
<code>READONLYoff</code>	Turns off read-only mode.

2.15 zModes

Once a CDF has been opened, it may be placed into one of two variations of `zMode`. `zMode` is fully explained in the Concepts chapter in the CDF User's Guide. A `zMode` is selected via `CDFsetzMode` method.

<code>zMODEoff</code>	Turns off <code>zMode</code> .
<code>zMODEon1</code>	Turns on <code>zMode/1</code> .
<code>zMODEon2</code>	Turns on <code>zMode/2</code> .

2.16 -0.0 to 0.0 Modes

Once a CDF has been opened, the CDF library may be told to convert `-0.0` to `0.0` when read from or written to that CDF. This mode is selected via `CDFsetNegtoPosfp0Mode` method.

<code>NEGtoPOSfp0on</code>	Convert <code>-0.0</code> to <code>0.0</code> when read from or written to a CDF.
<code>NEGtoPOSfp0off</code>	Do not convert <code>-0.0</code> to <code>0.0</code> when read from or written to a CDF.

2.17 Operational Limits

These are limits within the CDF library. If you reach one of these limits, please contact CDF User Support.

<code>CDF_MAX_DIMS</code>	Maximum number of dimensions for the <code>rVariables</code> or a <code>zVariable</code> .
<code>CDF_MAX_PARMS</code>	Maximum number of compression or sparseness parameters.

The CDF library imposes no limit on the number of variables, attributes, or attribute entries that a CDF may have. on the PC, however, the number of rVariables and zVariables will be limited to 100 of each in a multi-file CDF because of the 8.3 naming convention imposed by MS-DOS.

2.18 Limits of Names and Other Character Strings

CDF_PATHNAME_LEN	Maximum length of a CDF file name. A CDF file name may contain disk and directory specifications that conform to the conventions of the operating systems being used (including logical names on OpenVMS systems and environment variables on UNIX systems).
CDF_VAR_NAME_LEN	256 Maximum length of a variable name.
CDF_ATTR_NAME_LEN	256 Maximum length of an attribute name.
CDF_COPYRIGHT_LEN	Maximum length of the CDF Copyright text.
CDF_STATUSTEXT_LEN	Maximum length of the explanation text for a status code.

2.19 Backward File Compatibility with CDF 2.7

By default, a CDF file created by CDF V3.0 or a later release is not readable by any of the CDF releases before CDF V3.0 (e.g. CDF 2.7.x, 2.6.x, 2.5.x, etc.). The file incompatibility is due to the 64-bit file offset used in CDF 3.0 and later releases (to allow for files greater than 2G bytes). Note that before CDF 3.0, 32-bit file offset was used.

There are two ways to create a file that's backward compatible with CDF 2.7 and 2.6, but not 2.5. A method, **CDFsetFileBackward**, can be called to control the backward compatibility from an application before a CDF file is created (i.e. CDFcreateCDF). This method takes an argument to control the backward file compatibility. Passing a flag value of **BACKWARDFILEon**, defined in **CDFConstants**, to the method will cause new files being created to be backward compatible. The created files are of version V2.7.2, not V3.*. This option is useful for those who wish to create and share files with colleagues who still use a CDF V2.7/V2.6 library. If this option is specified, the maximum file size is limited to 2G bytes. Passing a flag value of **BACKWARDFILEoff** will use the default file creation mode and newly created files will not be backward compatible with older libraries. The created files are of version 3.* and thus their file sizes can be greater than 2G bytes. Not calling this method has the same effect of calling the method with an argument value of **BACKWARDFILEoff**.

The following example creates two CDF files: "MY_TEST1.cdf" is a V3.* file while "MY_TEST2.cdf" a V2.7 file.

```
.
.
void*      id1, id2;          /* CDF identifier. */
int  status;                /* Returned status code. */

try {
    status = CDFcreateCDF("MY_TEST1", &id1);
}
..
CDFsetFileBackward(BACKWARDFILEon);
status = CDFCreateCDF("MY_TEST2", &id2);
```

```

    } catch (CDFException ex) {
    }.
.

```

Another method is through an environment variable and no method call is needed (and thus no code change involved in any existing applications). The environment variable, **CDF_FILEBACKWARD** on Windows, is used to control the CDF file backward compatibility. If its value is set to “**TRUE**”, all new CDF files are backward compatible with CDF V2.7 and 2.6. This applies to any applications or CDF tools dealing with creation of new CDFs. If this environment variable is not set, or its value is set to anything other than “**TRUE**”, any files created will be of the CDF 3.* version and these files are not backward compatible with the CDF 2.7.2 or earlier versions .

Normally, only one method should be used to control the backward file compatibility. If both methods are used, the method call through **CDFsetFileBackward** will take the precedence over the environment variable.

You can use the **CDFgetFileBackward** method to check the current value of the backward-file-compatibility flag. It returns 1 if the flag is set (i.e. create files compatible with V2.7 and 2.6) or **0** otherwise.

```

.
.
int flag;                               /* Returned status code. */
.
flag = CDFgetFileBackward();

```

2.20 Checksum

To ensure the data integrity while transferring CDF files from/to different platforms at different locations, the checksum feature was added in CDF V3.2 as an option for the single-file format CDF files (not for the multi-file format). By default, the checksum feature is not turned on for new files. Once the checksum bit is turned on for a particular file, the data integrity check of the file is performed every time it is open; and a new checksum is computed and stored when it is closed. This overhead (performance hit) may be noticeable for large files. Therefore, it is strongly encouraged to turn off the checksum bit once the file integrity is confirmed or verified.

If the checksum bit is turned on, a 16-byte signature message (a.k.a. message digest) is computed from the entire file and appended to the end of the file when the file is closed (after any create/write/update activities). Every time such file is open, other than the normal steps for opening a CDF file, this signature, serving as the authentic checksum, is used for file integrity check by comparing it to the re-computed checksum from the current file. If the checksums match, the file’s data integrity is verified. Otherwise, an error message is issued. Currently, the valid checksum modes are: **NO_CHECKSUM** and **MD5_CHECKSUM**, both defined in **CDFConstants** class. With **MD5_CHECKSUM**, the **MD5** algorithm is used for the checksum computation. The checksum operation can be applied to CDF files that were created with V2.7 or later.

There are several ways to add or remove the checksum bit. One way is to use the method call with a proper checksum mode. Another way is through the environment variable. Finally, **CDFedit** and **CDFconvert** (CDF tools included as part of the standard CDF distribution package) can be used for adding or removing the checksum bit. Through the Interface call, you can set the checksum mode for both new or existing CDF files while the environment variable method only allows to set the checksum mode for new files.

The environment variable **CDF_CHECKSUM** on Windows is used to control the checksum option. If its value is set to “**MD5**”, all new CDF files will have their checksum bit set with a signature message produced by the MD5 algorithm. If the environment variable is not set or its value is set to anything else, no checksum is set for the new files.

The following example set a new CDF file with the MD5 checksum and set another existing file’s checksum to none.


```

.
.
.
void*      id1, id2;          /* CDF identifier. */
int  status;                 /* Returned status code. */
int  checksum;              /* Checksum code. */
.
.
status = CDFCreateCDF("MY_TEST1", &id1);
.
status = CDFsetChecksum(id1, MD5_CHECKSUM);
.
status = CDFclose(id1);
.
status = CDFopen("MY_TEST2", &id2);
.
status = CDFsetChecksum(id2, NO_CHECKSUM);
.
status = CDFclose(id2);
.
.

```

2.21 Data Validation

To ensure the data integrity of CDF files and secure operation of CDF-based applications, a data validation feature has been added to the CDF opening logic. This process, as the default, performs sanity checks on the data fields in the CDF's internal data structures to make sure that the values are within valid ranges and consistent with the defined values/types/entries. It also ensures that the variable and attribute associations within the file are valid. Any compromised CDF files, if not validated properly, could cause applications to function unexpectedly, e.g., segmentation fault due to a buffer overflow. The main purpose of this feature is to safeguard the CDF operations, catch any bad data in the file and end the application gracefully if any bad data is identified. Using this feature, in most cases, will slow down the file opening process especially for large or very fragmented files. Therefore, it is recommended that this feature be turned off once a file's integrity is confirmed or verified. Or, the file in question may need a file conversion, which will consolidate the internal data structures and eliminate the fragmentations. Check the **cdfconvert** tool program in the CDF User's Guide for further information. ⁶

This validation feature is controlled by setting/unsetting the environment variable **CDF_VALIDATE** on Windows is not set or set to "yes", all CDF files are subjected to the data validation process. If the environment variable is set to "no", then no validation is performed. The environment variable can be set at logon or through the command line, which goes into effect during a terminal session, or within an application, which is good only while the application is running. Setting the environment variable, using C method **CDFsetValidate**, at application level will overwrite the setup from the command line. The validation is set to be on when **VALIDATEFILEon** is passed in as an argument. **VALIDATEFILEoff** will turn off the validation. The function, **CDFgetValidate**, will return the validation mode, **1** (one) means data being validated, **0** (zero) otherwise. If the environment variable is not set, the default is to validate the CDF file upon opening.

The following example sets the data validation on when the CDF file, "TEST", is open.

```

.
.

```

⁶ The data validation during the open process will not check the variable data. It is still possible that data could be corrupted, especially compression is involved. To fully validate a CDF file, use **cdfdump** tool with "-detect" switch.

```

void*      id                /* CDF identifier. */
int  status                /* Returned status code. */
.
.
CDFsetValidate (VALIDATEFILEon)
status = CDFopen("TEST", &id);
.
.

```

The following example turns off the data validation when the CDF file, "TEST" is open.

```

.
.
.
void*      id                /* CDF identifier. */
int  status                /* Returned status code. */
.
.
CDFsetValidate (VALIDATEFILEoff)
status = CDFopen("TEST", &id);
.
.

```

2.22 8-Byte Integer

Both data types of CDF_INT8 and CDF_TIME_TT2000 use 8-bytes signed integer. C#'s "long" type is the one that matches to these two types.

2.23 Leap Seconds

CDF's CDF_TIME_TT2000 is the epoch value in nanoseconds since **J2000** (2000-01-01T12:00:00.000000000) with leap seconds included. The CDF uses an external or internal table for computing the leap seconds. The external table, if present and properly pointed to by a predefined environment variable, will be used over the internal one. When the C# package is installed, the external table and environment variables are set so it can be used. If the external table is deleted or no longer pointed by the environment variable, the internal, hard-coded table in the library is used. When a new leap second is added, if the external table is updated accordingly, then the software does not need to be upgraded. Refer to CDF User's Guide for leap seconds.

A tool program, **CDFleapsecondsInfo** distributed with the CDFpackage, will show how the table is referred and when the last leap second was added. Optionally, it can dump the table contents.

Chapter 3

3 Understanding the Application Interface

This chapter provides some basic information about the C#'s Application Interfaces (APIs) to CDF, and the native CDF .DLL. The following chapter will describe each API in detail.

3.1 Unsafe Code and Pointers

To manipulate CDFs, pointers are used extensively in CDF APIs to interact with the CDF native .DLL. The CDF file structure object itself is presented as a pointer of void (**void***) once a CDF is opened or created. Data from CDF is read or written through the API calls via pointers directly or indirectly. All APIs for CDF operations and Epoch utilities are built as **unsafe** code. The C# applications, while calling CDF APIs, have to be declared as unsafe as well. Compilation of the applications needs to specify the “**unsafe**” option.

3.2 Overloaded Methods and Arguments Passing

Each CDF API has a sequence of parameters, which define the set of arguments that must be provided for that method in C# applications. Being a strongly typed language, C#'s APIs to CDF follow the same rules for the parameters. APIs that perform CDF data get, put or inquire operations are overloaded as different signatures for the output parameters would make method calls more flexible.

The input parameters in APIs such as the CDF identifier, variable number, attribute number, entry number, record number, record counts and record indices, etc, are always of fixed types as they must be a scalar of type **void*** for CDF identifier, **int** for variable/attribute/entry number and record number/count, or an array of ints, or an array of ints, **int[]**, for record indices or indices counts. Compilation error will occur if any one of the such arguments from the applications does not match to that defined in the API. The output parameters can be in one of the allowable forms defined by the overloaded API methods. For example, for a returned data, var, of type int, the passing argument in the calling application can be either “out var” or &var, a pointer to the declared int variable.

For example, **CDFsetEncoding** and **CDFgetEncoding** are used to set and get the data encoding of a CDF. Both APIs take two parameters, the CDF identifier, always a pointer as **void***, and the encoding, an int. **CDFsetEncoding** take both parameters from applications for input, while **CDFgetEncoding** has the CDF identifier as input and the encoding for output. The following code shows how these methods can be used.

To set a CDF's encoding,

```
int status;
void* id;
int encoding;
...
encoding = IBMPC_ENCODING;
status = CDFsetEncoding(id, encoding);
```

The CDF identifier, id, is set when a CDF is open or created. The encoding is set to PC encoding, defined in CDFConstants class.

Similarly, to get the CDF's encoding:

```
status = CDFgetEncoding(id, out encoding);
```

The "out" argument modifier is specified in the call as it will get the encoding value from the API.

This data inquiry method is overloaded. Alternatively, it can be called by passing in the pointer of the encoding:

```
status = CDFgetEncoding(id, &encoding);
```

APIs that read or write CDF data, either variable's data (and their pad value) or metadata, are overloaded as they need to be more flexible when dealing with data of different pre-defined CDF types, e.g., CDF_INT1, CDF_UINT1, CDF_FLOAT, CDF_CHAR, CDF_EPOCH, etc. To pass the data value(s) to the APIs, one of the following forms can be used, depending on the data type: **pointer, string, an array of strings or object**. To use data pointers in the API calls, the data has to be of a **numeric type** and **pre-allocated** if the parameter is a dimensional object. String or an array of strings involves data of **CDF_CHAR** or **CDF_UCHAR** type. As C#'s character/string has a different characteristic from the ASCII-based code in the CDF native DLL library, some manipulations are needed in APIs when dealing with such data. C# objects can be used, as a general form for all data value(s), when reading/writing data from CDF. The called APIs will handle the passed object and map it to its corresponding CDF data type. **Boxing/unboxing** the objects presented by the APIs and/or applications may be needed.

For example, overloaded methods: **CDFputzVarData** and **CDFgetzVarData** are used to write and read a **single data value** for an zVariable in a CDF. Both take five parameters: the first four, for input, are the CDF identifier, variable number, record number and indices with fixed types of: **void***, **int**, **int** and an **array of ints (int[])**, respectively, and the last parameter is for data value, as an input for CDFputzVarData or an output for CDFgetzVarData. To call CDFputzVarData, the data value can be passed in as is or use data value's pointer if the data is a numeric. To retrieve the data by CDFgetzVarData, either specify the "out" modifier for the value argument, or pass in the data value's pointer if the data is a numeric.

The following samples show how these arguments are set up to write a data value to record 1, indices [1,1] for zVariable, "zVar1", a 2-dimensional of CDF_INT2. The first one uses the data value as is:

```
int status;
void* id;
int varNum;
int recNum = 1;
int[] indices = new int[] {1,1};
short value = (short) 100;
...
varNum = CDFvarNum(id, "zVar1");
status = CDFputzVarData(id, varNum, recNum, indices, value);
```

Alternatively, the **pointer** to the value argument can be used:

```
...
status = CDFputzVarData(id, varNum, recNum, indices, &value);
```

To read the data value the same variable at the same record and indices: a **pointer** or “out” modifier can be used for the value argument:

short value;

```
...
status = CDFgetzVarData(id, varNum, recNum, indices, out value);
```

Alternatively, the **pointer** to the value argument can be used:

```
...
status = CDFgetzVarData(id, varNum, recNum, indices, &value);
```

If value is declared as an object, instead of its specific type short, use the proper **type casting** to unbox the object after the data is returned.

```
...
object value;
status = CDFgetzVarData(id, varNum, recNum, indices, out value);
short value1 = (short) value;
```

Overloaded APIs that handle the reads and writes of **multiple data values**, have the similar ways of passing arguments. **CDFputzVarRecordData** and **CDFgetzVarRecordData** are two APIs that are used to write and read a full data record, either a scalar or dimensional data, for an zVariable. They both take four parameters: the first three, as input, are the CDF identifier, variable number, record number of the fixed types: **void***, **int** and **int**, respectively, and the last one is data values as an input for CDFputzVarRecordData or output for CDFgetzVarRecordData. Calling CDFputzVarRecordData, the data values object can be passed in as is or use object’s pointer if the data are numeric. The values object parameter in CDFgetzVarRecordData can be declared with its data type and dimensionality, and is passed in with the “**out**” modifier as **out string**, **array of strings**, as **out string[]**, or **out object**. For numeric type data values, the argument can be passed in as a pointer, as **void***.

The following samples show how the arguments are set in CDFputzVarRecordData to write the full record 1 for zVariable, “zVar1”, a 2-dim [2,3] of type short. The first one passes the data value object as is, while the second one uses a pointer to the data values.

```
int status;
void* id;
int varNum;
int recNum = 1;
short[,] values = new short[2,3] {{1,2,3},{11,12,13}};
...
varNum = CDFvarNum(id, “zVar1”);
status = CDFputzVarRecordData(id, varNum, recNum, values);
```

Alternatively, a pointer to the array of numeric values can be used:

```
fixed (void* pvalues = values) {
    status = CDFputzVarRecordData(id, varNum, recNum, pvalues);
}
```

To use a pointer for the data values, its object needs to be pre-allocated. A **fixed** statement is required to pin the numeric data value array object to avoid garbage collector moving the object around during the call.

For CDFgetzVarRecordData to read back the same variable's record data, one can use "out" modifier for the data values, or pass in a pointer to the pre-allocated data array.

```
void* id;
int varNum;
int recNum = 1;
short[,] values ;
...
varNum = CDFvarNum(id, "zVar1");
status = CDFgetzVarRecordData(id, varNum, recNum, out values);
```

```
Console.WriteLine(values[0.0]+","+ values[0.1]+","+ values[0.2]+"\\n"+
    values[1.0]+","+ values[1.1]+","+ values[1.2]);
```

Alternatively, allocate the array with its type and dimensionality, and pass in the pointer:

```
short[,] values = new short[2,3];
...
fixed (void* pvalues = values) {
    status = CDFgetzVarRecordData(id, varNum, recNum, pvalues);
}
```

```
Console.WriteLine(values[0.0]+","+ values[0.1]+","+ values[0.2]+"\\n"+
    values[1.0]+","+ values[1.1]+","+ values[1.2]);
```

If the data values, in this case, is declared as a base class object, instead of a two-dimensional short, the API will determine the variable's data type and dimensionality and create the data object accordingly before the data values are read. Unboxing the object with a proper type and dimensionality casting is needed after the object is returned.

```
object values;
status = CDFgetzVarRecordData(id, varNum, recNum, out values);
```

```
Console.WriteLine(((short[,])values)[0.0]+","+ ((short[,])values)[0.1]+","+ ((short[,])values)[0.2]+"\\n"+
    ((short[,])values)[1.0]+","+ ((short[,])values)[1.1]+","+ ((short[,])values)[1.2]);
```

NOTE: Using the pointers to pass in the pre-allocated data objects is limited to numeric types. For data read/write operations, it should have a better performance than passing base class objects as APIs with pointers can directly interact with the CDF native .DLL. If a method returns multiple values, either use pointers for all those output arguments, or use "out" modifier for all of them. Mixing pointers and "out" modifier arguments in a call is not supported.,

Pointers can not be used for string data, being a CDF_CHAR or CDF_UCHAR type in a CDF, as different characteristics between the C# characters and the CDF ASCII based library. The data needs to be declared as a string or array of strings, or simply a base class object, if an output operation involve such type. Use base class object for read operations that involve string array data of more than one dimension.

For example, if variable zVar1 is a one dimensional of two elements, of type CDF_CHAR. This sample code will retrieve both strings from the second record from the variable:

```
int status;
void* id;
int varNum;
int recNum = 1;
```

```

string[] strings;
...
...
varNum = CDFvarNum(id, "zVar1");
status = CDFgetzVarRecordData(id, varNum, recNum, out strings);

Console.WriteLine(strings[0]+","+ strings[1]);

```

If value strings is declared as an object, instead of an array of strings, then unboxing the object is needed when it is returned.

```

object strings;
status = CDFgetzVarRecordData(id, varNum, recNum, out strings);

Console.WriteLine(((string[])strings)[0]+","+ ((string[])strings)[1]);

```

3.3 Multi-Dimensional Arrays

For data involved multidimensional arrays, CDF's native .DLL data structure is equivalent to the **rectangular array** in C#. Multidimensional arrays of jagged type are not supported by APIs. An extra dimension is added to the retrieved data if the operations involve multiple records. For example, to read two full records from a variable of two-dimensions, 3-by-4 by the hyper get method, the returned will be a three-dimensional, 2-by-3-by-4, object. Conversely, if the hyper read skips certain dimension(s) from an operation, the returned object's dimensionality will be reduced accordingly. For example, to read a row or column from a variable's two-dimensional record, the returned will be a single array of either column or row count.

3.4 Data Type Equivalent

The following list shows the data types used by CDF and their corresponding types in C#:

- CDF_INT1 sbyte
- CDF_INT2 short
- CDF_INT4 int
- CDF_INT8 long
- CDF_UINT1 byte
- CDF_UINT2 ushort
- CDF_UINT4 uint
- CDF_BYTE sbyte
- CDF_REAL float
- CDF_FLOAT float
- CDF_DOUBLE double
- CDF_REAL8 double
- CDF_EPOCH double
- CDF_EPOCH16 double[2]
- CDF_TIME_TT2000 long
- CDF_CHAR string (with manipulation)
- CDF_UCHAR string (with manipulation)

3.5 Fixed Statement

Fixed statement is required to pin C# managed data objects, mainly arrays of numeric data, so that pointers of the objects can be safely used and passed to the CDF APIs. By doing so, the objects' addresses in the heap won't be moved around by the garbage collector during the operation.

For example, `CDFhyperGetzVarData` method can be called to retrieve a number of data values for a `zVariable`. For instance, the following application code can be used to read the first four (4) records from a `zVariable` of 2-dim [2,3] of type `CDF_INT4`. The declared data buffer, a 3-dimensional of `int`, is blocked in the fixed statement when the call is made.

```
void*   id;
void    status;
int     varNum;
int     recNum = 0, recCount = 4, recInterval = 1;
int[,]  indices = new int[,] {0, 0};
int[,]  counts = new int[,] {2, 3};
int[,]  intervals = new int[,] {1,1};
int [,] data = new int[4,2,3];           /* Dimension: record number, row, column */
...
...
fixed (void* pdata = data) {
    status = CDFhyperGetzVarData (id, varNum, recNum, recCount, recInterval, indices, counts, intervals, pdata);
}
...
.
```

3.6 Exception Handling

Except a few APIs, each call to a CDF method will return an operation status. If the status is abnormal, less than `CDF_OK`, an exception might be thrown. It is recommended that the code for the CDF-based application be surrounded by a try-catch block so an exception can be caught and handled. The methods to check the existence of a CDF entity, e.g., entry, attribute, variable, will not throw exception if that entity is not in the CDF. The returned, informational status will reflect so. Once an exception is thrown, the thrown object, if initiated from the CDF APIs, is a `CDFException` class object. There are a couple of class methods, **`GetCurrentStatus`** and **`GetStatusMsg`**, which can be used to acquire the status when an exception is thrown and the descriptive information about that exception.

```
void*   id;
int     status;
int     encoding;
try {
    status = CDFopen("TEST", &id);
    ...
    status = CDFgetEncoding(id, &encoding);
    ....
    status = CDFclose(id);
} catch (CDFException ex) {
```

```
Console.WriteLine("Exception: "+ex);  
Or,  
int status1 = ex.GetCurrentStatus();  
Console.WriteLine("Exception: "+ex.GetStatusMsg(status1));  
}
```

3.7 Dimensional Limitations

The C# to CDF APIs follow the same dimensional restriction as in the CDF native DLL: a limit of **ten** (10) dimensions a CDF variable's numeric typed data record can have. For **string** typed data, represented in a CDF file with CDF_CHAR or CDF_UCHAR type, a limit of four (4) dimensions is applied.

Chapter 4

4 Application Interface

This chapter covers all Application Interfaces (APIs) that C# programs can interact with CDF. These APIs are based on the CDF native extended Standard Interface functions: they bear the same names with the similar calling arguments. They are easier to develop and use, and require a much shorter learning curve. All these APIs are defined as static methods in **CDFAPIs** class.

There are two types of variables (rVariable and zVariable) in CDF, and they can happily coexist in a CDF: Every rVariable in a CDF must have the same number of dimensions and dimension sizes while each zVariable can have its own dimensionality. Since all the rVariables in a CDF must have the same dimensions and dimension sizes, there'll be a lot of disk space wasted if a few variables need big arrays and many variables need small arrays. Since zVariable is more efficient in terms of storage and offers more functionality than rVariable, use of zVariable is strongly recommended. As a matter of fact, there's no reason to use rVariables at all if you are creating a CDF file from scratch. One may wonder why there are rVariables and zVariables, not just zVariables. When CDF was first introduced, only rVariables were available. The inefficiencies with rVariables were quickly realized and addressed with the introduction of zVariables in later CDF releases.

The description for each API will detail its parameters: their types, for input or output; and what the method returns. APIs that are **overloaded** use a special indicator, **TYPE** (and **TYPE2**, **TYPE3**, etc, if necessary), to specify the parameters that can have different signatures. The acceptable data types for each overloaded method are specified. For example, **CDFgetEncoding** method, returning a CDF's encoding, is described as:

```
int CDFgetEncoding (                                     /* out -- Completion status code. */
void* id,                                               /* in -- CDF identifier. */
TYPE encoding);                                       /* out -- CDF encoding. */
                                                    /* TYPE -- int* or "out int" */
```

TYPE can be a pointer to an int, ***int**, or an argument modifier "out" for an int object as "**out int**". The following application shows how the API is used:

```
int status;
int encoding;
void* id;
....
status = CDFgetEncoding(id,&encoding);
Or,
status = CDFgetEncoding(id, out encoding);
```

APIs are grouped based on the CDF entity they operate on. These groups are for general library information, CDF as a whole, variable and attribute/entry.

4.1 Library Information

The functions in this section are related to the current CDF library being used for the CDF operations, and they provide useful information such as the current library version number and Copyright notice.

4.1.1 CDFgetDataTypeSize

```
int CDFgetDataTypeSize (                               /* out -- Completion status code. */
int dataType,                                         /* in -- CDF data type. */
TYPE numBytes);                                       /* out -- # of bytes for the given type. */
                                                         /* TYPE -- int* or out int */
```

CDFgetDataTypeSize returns the size (in bytes) of the specified CDF data type.

The arguments to CDFgetDataTypeSize are defined as follows:

dataType	The CDF supported data type.
numBytes	The size of dataType.

4.1.1.1. Example(s)

The following example returns the size of the data type CDF_INT4 that is 4 bytes.

```
.
.
.
int status;                                           /* Returned status code. */
int numBytes;                                        /* Number of bytes. */
.
.
try {
...
status = CDFgetDataTypeSize(CDF_INT4, &numBytes);
...
...
} catch (CDFException ex) {
...
}.
.
```

4.1.2 CDFgetLibraryCopyright

```
int CDFgetLibraryCopyright (                               /* out -- Completion status code. */
out string  copyright);                                   /* out -- Library copyright. */
```

CDFgetLibraryCopyright returns the Copyright notice of the CDF library being used.

The arguments to CDFgetLibraryCopyright are defined as follows:

Copyright	The Copyright notice.
-----------	-----------------------

4.1.2.1. Example(s)

The following example returns the Copyright of the CDF library being used.

```
.
.
.
int  status;                               /* Returned status code. */
string  copyright;                         /* CDF library copyright. */
.
.
try {
    ....
    status = CDFgetLibraryCopyright(out copyright);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.1.3 CDFgetLibraryVersion

```
int CDFgetLibraryVersion (                               /* out -- Completion status code. */
TYPE  version,                                       /* out -- Library version. */
TYPE  release,                                       /* out -- Library release. */
TYPE  increment,                                     /* out -- Library increment. */
out string  subIncrement);                           /* out -- Library sub-increment. */
/* TYPE -- int* or "out int" */
```

CDFgetLibraryVersion returns the version and release information of the CDF library being used.

The arguments to CDFgetLibraryVersion are defined as follows:

version	The library version number.
release	The library release number.
increment	The library incremental number.

subIncrement The library sub-incremental string, a single character.

4.1.3.1. Example(s)

The following example returns the version and release information of the CDF library that is being used.

```
.
.
.
int  status;           /* Returned status code. */
int  version;         /* CDF library version number. */
int  release;        /* CDF library release number. */
int  increment;      /* CDF library incremental number. */
string  subIncrement; /* CDF library sub-incremental character. */
.
.
try {
    ....
    status = CDFgetLibraryVersion(&version, &release, &increment, out subIncrement);
..or,
    status = CDFgetLibraryVersion(out version, out release, out increment, out subIncrement);
...
...
} catch (CDFException ex) {
    ...
}.
.
```

4.1.4 CDFgetStatusText

```
int CDFgetStatusText( /* out -- Completion status code. */
int status,          /* in -- The status code. */
out string message); /* out -- The status text description. */
```

CDFgetStatusText is identical to CDFError, a legacy CDF function, (see section 4.2.8), and the use of this method is strongly encouraged over CDFError as it might not be supported in the future. This method is used to inquire the text explanation of a given status code. Chapter 5 explains how to interpret status codes and Appendix A lists all of the possible status codes.

The arguments to CDFgetStatusText are defined as follows:

status	The status code to check.
message	The explanation of the status code.

4.1.4.1. Example(s)

The following example displays the explanation text for the error code that is returned from a call to CDFopenCDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    text;       /* Explanation text. */
.
.
try {
    ....
    status = CDFopenCDF ("giss_wet1", &id);
    ...
    status = CDFclose(id);
.
} catch (CDFException ex) {
    text = CDFgetStatusMsg(ex.CDFgetCurrentStatus());...
}.

```

4.2 CDF

The functions in this section provide CDF file-specific operations. Any operations involving variables or attributes are described in the following sections. This CDF has to be a newly created or opened from an existing one.

4.2.1 CDFclose

```

int CDFclose(          /* out -- Completion status code. */
void* id);           /* in -- CDF identifier. */

```

CDFclose closes the specified CDF. The CDF's cache buffers are flushed; the CDF's open file is closed (or files in the case of a multi-file CDF); and the CDF identifier is made available for reuse.

NOTE: You must close a CDF with CDFclose to guarantee that all modifications you have made will actually be written to the CDF's file(s). If your program exits, normally or otherwise, without a successful call to CDFclose, the CDF's cache buffers are left unflushed.

The arguments to CDFclose are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.

4.2.1.1. Example(s)

The following example will close an open CDF.

```

.
.

```



```

.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFopen("...", &id);
    status = CDFclose (id);
} catch (CDFException ex) {
    ...
}.

```

4.2.2 CDFcloseCDF

```

int CDFcloseCDF (          /* out -- Completion status code. */
void* id);                /* in -- CDF identifier. */

```

CDFcloseCDF closes the specified CDF. This method is identical to CDFclose, a legacy CDF function. The use of this method is strongly encouraged over CDFclose as it might not be supported in the future. The CDF's cache buffers are flushed; the CDF's open file is closed (or files in the case of a multi-file CDF); and the CDF identifier is made available for reuse.

NOTE: You must close a CDF with CDFcloseCDF to guarantee that all modifications you have made will actually be written to the CDF's file(s). If your program exits, normally or otherwise, without a successful call to CDFcloseCDF, the CDF's cache buffers are left unflushed.

The arguments to CDFcloseCDF are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreateCDF or CDFopenCDF.

4.2.2.1. Example(s)

The following example will close an open CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFopenCDF ("giss_wet1", &id);
    ...
    status = CDFcloseCDF (id);
} catch (CDFException ex) {
    ...
}

```

```
    }.
```

4.2.3 CDFcreate

```
int CDFcreate(                                     /* out -- Completion status code. */
string CDFname,                                  /* in -- CDF file name. */
int numDims,                                    /* in -- Number of dimensions, rVariables. */
int[] dimSizes,                                 /* in -- Dimension sizes, rVariables. */
int encoding,                                   /* in -- Data encoding. */
int majority,                                   /* in -- Variable majority. */
void* *id);                                     /* out -- CDF identifier. */
```

CDFcreate, a legacy CDF function, creates a CDF as defined by the arguments. A CDF cannot be created if it already exists. (The existing CDF will not be overwritten.) If you want to overwrite an existing CDF, you must first open it with CDFopenCDF, delete it with CDFdeleteCDF, and then recreate it with CDFcreate. If the existing CDF is corrupted, the call to CDFopen will fail. (An error code will be returned.) In this case you must delete the CDF at the command line. Delete the dotCDF file (having an extension of .cdf), and if the CDF has the multi-file format, delete all of the variable files (having extensions of .v0,.v1,. . . and .z0,.z1,. . .).

The arguments to CDFcreate are defined as follows:

CDFname	The file name of the CDF to create. (Do not specify an extension.) This may be at most CDF_PATHNAME_LEN characters. A CDF file name may contain disk and directory specifications that conform to the conventions of the operating system being used (including logical names on OpenVMS systems and environment variables on UNIX systems). UNIX: File names are case-sensitive.
numDims	Number of dimensions the rVariables in the CDF are to have. This may be as few as zero (0) and at most CDF_MAX_DIMS.
dimSizes	The size of each dimension. Each element of dimSizes specifies the corresponding dimension size. Each size must be greater than zero (0). For 0-dimensional rVariables this argument is ignored (but must be present).
encoding	The encoding for variable data and attribute entry data. Specify one of the encodings described in Section 2.7.
majority	The majority for variable data. Specify one of the majorities described in Section 2.9.
id	Identifier for the created CDF. This identifier must be used in all subsequent operations on the CDF.

When a CDF is created, both read and write access are allowed. The default format for a CDF created with CDFcreate is specified in the configuration file of your CDF distribution. Consult your system manager for this default.

NOTE: CDFclose must be used to close the CDF before your application exits to ensure that the CDF will be correctly written to disk.

4.2.3.1. Example(s)

The following example creates a CDF named "test1.cdf" with network encoding and row majority.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numDims = 3;     /* Number of dimensions, rVariables. */
int[] dimSizes = new int[] {180,360,10}; /* Dimension sizes, rVariables. */
int  majority = ROW_MAJOR; /* Variable majority. */
.
.
try {
    status = CDFcreate ("test1", numDims, dimSizes, NETWORK_ENCODING, majority, &id);
.
} catch (CDFException ex) {
    ...
}.

```

4.2.4 CDFcreateCDF

```
int CDFcreateCDF(          /* out -- Completion status code. */
string cdfName,          /* in -- CDF file name. */
void* *id);             /* out -- CDF identifier. */
```

CDFcreateCDF creates a CDF file. This method is a simple form of CDFcreate without the number of dimensions, dimensional sizes, encoding and majority arguments. It is the better method if only zVariables are to be created in the CDF. The created CDF will use the default encoding (HOST_ENCODING) and majority (ROW_MAJOR). A CDF cannot be created if it already exists. (The existing CDF will not be overwritten.) If you want to overwrite an existing CDF, you can either manually delete the file or open it with CDFopenCDF, delete it with CDFdeleteCDF, and then recreate it with CDFcreateCDF. If the existing CDF is corrupted, the call to CDFopenCDF will fail. (An error code will be returned.) In this case you must delete the CDF at the command line. Delete the dotCDF file (having an extension of .cdf), and if the CDF has the multi-file format, delete all of the variable files (having extensions of .v0,.v1,. . . and .z0,.z1,. . .).

Note that a CDF file created with CDFcreateCDF can only accept zVariables, not rVariables. But this is fine since zVariables are more flexible than rVariables. See the third paragraph of Chapter 3 for the differences between rVariables and zVariables.

The arguments to CDFcreateCDF are defined as follows:

- | | |
|---------|--|
| CDFname | The file name of the CDF to create. (Do not specify an extension.) This may be at most CDF_PATHNAME_LEN characters. A CDF file name may contain disk and directory specifications that conform to the conventions of the operating system being used (including logical names on OpenVMS systems and environment variables on UNIX systems). |
| | UNIX: File names are case-sensitive. |
| id | Identifier for the created CDF. This identifier must be used in all subsequent operations on the CDF. |

When a CDF is created, both read and write access are allowed. The default format for a CDF created with `CDFcreateCDF` is specified in the configuration file of your CDF distribution. Consult your system manager for this default.

NOTE: `CDFcloseCDF` must be used to close the CDF before your application exits to ensure that the CDF will be correctly written to disk.

4.2.4.1. Example(s)

The following example creates a CDF named “test1.cdf” with the default encoding and majority.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFcreateCDF ("test1", &id);
    ...
    ...
    status = CDFclose (id);
} catch (CDFException ex) {
    ...
}
```

4.2.5 CDFdelete

```
int CDFdelete(          /* out -- Completion status code. */
void* id);             /* in -- CDF identifier. */
```

`CDFdelete`, a legacy CDF function, deletes the specified CDF. The CDF files deleted include the dotCDF file (having an extension of `.cdf`), and if a multi-file CDF, the variable files (having extensions of `.v0`, `.v1`, . . . and `.z0`, `.z1`, . . .).

You must open a CDF before you are allowed to delete it. If you have no privilege to delete the CDF files, they will not be deleted. If the CDF is corrupted and cannot be opened, the CDF file(s) must be deleted at the command line.

The arguments to `CDFdelete` are defined as follows:

`id` Identifier of the CDF. This identifier must have been initialized by a call to `CDFcreate` (or `CDFcreateCDF`) or `CDFopen`.

4.2.5.1. Example(s)

The following example will open and then delete an existing CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFopen ("test2", &id);
    status = CDFdelete (id);
.
} catch (CDFException ex) {
    ...
}.

```

4.2.6 CDFdeleteCDF

```

int CDFdeleteCDF(          /* out -- Completion status code. */
void* id);                /* in -- CDF identifier. */

```

CDFdeleteCDF deletes the specified CDF. This method is identical to CDFdelete, and the use of this method is strongly encouraged over CDFdelete as it might not be supported in the future. The CDF files deleted include the dotCDF file (having an extension of .cdf), and if a multi-file CDF, the variable files (having extensions of .v0,.v1,. . . and .z0,.z1,. . .).

You must open a CDF before you are allowed to delete it. If you have no privilege to delete the CDF files, they will not be deleted. If the CDF is corrupted and cannot be opened, the CDF file(s) must be deleted at the command line.

The arguments to CDFdeleteCDF are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.

4.2.6.1. Example(s)

The following example will open and then delete an existing CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFopenCDF ("test2", &id);
    ...
    status = CDFdeleteCDF(id);
.
}

```

```

...
} catch (CDFException ex) {
...
}.

```

4.2.7 CDFdoc

```

int CDFdoc(                                     /* out -- Completion status code. */
void* id,                                       /* in -- CDF identifier. */
TYPE version,                                  /* out -- Version number. */
TYPE release,                                  /* out -- Release number. */
out string copyright);                          /* out -- copyright. */
/* TYPE -- int* or "out int" */

```

CDFdoc is used to inquire general information about a CDF. The version/release of the CDF library that created the CDF is provided (e.g., CDF V3.1 is version 3, release 1) along with the CDF copyright notice. The copyright notice is formatted for printing without modification.

The arguments to CDFdoc are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
version	The version number of the CDF library that created the CDF.
release	The release number of the CDF library that created the CDF.
copyright	The Copyright notice of the CDF library that created the CDF. This string will contain a newline character after each line of the Copyright notice.

4.2.7.1. Example(s)

The following example returns and displays the version/release and copyright notice.

```

.
.
void*      id;                                  /* CDF identifier. */
int  status;                                  /* Returned status code. */
int  version;                                  /* CDF version number. */
int  release;                                  /* CDF release number. */
string copyright;                              /* Copyright notice. */
.
.
try {
....
status = CDFdoc (id, &version, &release, out copyright);
Or,
status = CDFdoc (id, out version, out release, out copyright);
.

```

```

} catch (CDFException ex) {
    ...
}.

```

4.2.8 CDFerror⁷

```

int CDFerror(                                     /* out -- Completion status code. */
int status,                                     /* in -- Status code. */
out string message);                             /* out -- Explanation text for the status. */

```

CDFerror, a legacy CDF function, is used to inquire the explanation of a given status code (not just error codes). Chapter 5 explains how to interpret status codes and Appendix A lists all of the possible status codes.

The arguments to CDFerror are defined as follows:

status	The status code to check.
message	The explanation of the status code.

4.2.8.1. Example(s)

The following example displays the explanation text if an error code is returned from a call to CDFopen.

```

.
.
.
void*      id;                                     /* CDF identifier. */
int        status;                                 /* Returned status code. */
string     text;                                   /* Explanation text. */
.
.
try {
    ....
    status = CDFopen ("giss_wetl", &id);
.
} catch (CDFException ex) {
    int status1 = CDFerror(ex.GetCurrentStatus(), out text); ...
}.

```

4.2.9 CDFgetCacheSize

```

int CDFgetCacheSize (                             /* out -- Completion status code. */
void* id,                                         /* in -- CDF identifier. */
TYPE numBuffers);                                 /* out -- CDF's cache buffers. */

```

⁷ A legacy CDF function. While it is still available in V3.1, CDFgetStatusText is the preferred function for it.

/ TYPE -- int* or "out int" */*

CDFgetCacheSize returns the number of cache buffers being used for the dotCDF file when a CDF is open. Refer to the CDF User's Guide for description of caching scheme used by the CDF library.

The arguments to CDFgetCacheSize are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreateCDF (or CDFcreate) or CDFopen.
numBuffers	Number of cache buffers.

4.2.9.1. Example(s)

The following example returns the cache buffers for the open CDF file.

```
.  
. .  
. .  
void*      id;           /* CDF identifier. */  
int  status;           /* Returned status code. */  
int  numBuffers;       /* CDF's cache buffers. */  
. .  
. .  
try {  
    ....  
    status = CDFgetCacheSize (id, &numBuffers);  
    Or,  
    status = CDFgetCacheSize (id, out numBuffers);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
.
```

4.2.10 CDFgetChecksum

```
int CDFgetChecksum (           /* out -- Completion status code. */  
void* id,                   /* in -- CDF identifier. */  
TYPE checksum);            /* out -- CDF's checksum mode. */  
                          /* TYPE -- int* or "out int" */
```

CDFgetChecksum returns the checksum mode of a CDF. The CDF checksum mode is described in Section 2.20.

The arguments to CDFgetChecksum are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreateCDF (or CDFcreate) or CDFopen.
checksum	The checksum mode (NO_CHECKSUM or MD5_CHECKSUM).

4.2.10.1. Example(s)

The following example returns the checksum code for the open CDF file.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  checksum;        /* CDF's checksum. */
.
.
try {
    ....
    status = CDFgetChecksum (id, &checksum);
    Or,
    status = CDFgetChecksum (id, out checksum);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.11 CDFgetCompression

```
int CDFgetCompression (          /* out -- Completion status code. */
void* id,                      /* in -- CDF identifier. */
TYPE compressionType,         /* out -- CDF's compression type. */
TYPE2 compressionParms,      /* out -- CDF's compression parameters. */
TYPE compressionPercentage); /* out -- CDF's compressed percentage. */
/* TYPE -- int* or "out int" */
/* TYPE2 -- int* or "out int[]" */
```

CDFgetCompression gets the compression information of the CDF. It returns the compression type (method) and, if compressed, the compression parameters and compression rate. CDF compression types/parameters are described in Section 2.11. The compression percentage is the result of the compressed file size divided by its original, uncompressed file size.⁸

The arguments to CDFgetCompression are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
compressionType	The type of the compression.
compressionParms	The parameters of the compression.

⁸ The compression ratio is (100 – compression percentage): the lower the compression percentage, the better the compression ratio.

compressionPercentage The compression rate.

4.2.11.1. Example(s)

The following example returns the compression information of the open CDF file.

```
.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  compressionType;  /* CDF's compression type. */
int[] compressionParms /* CDF's compression parameters. */
int  compressionPercentage; /* CDF's compression rate. */
.
.
try {
    ....
    compressionParms = new int[1];
    fixed (int* pcompressionParms = compressionParms) {
        status = CDFgetCompression (id, &compression, pcompressionParms, &compressionPercentage);
    }
    Or,
    status = CDFgetCompression (id, out compression, out compressionParms, out compressionPercentage);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.12 CDFgetCompressionCacheSize

```
int CDFgetCompressionCacheSize (           /* out -- Completion status code. */
void* id,                                  /* in -- CDF identifier. */
TYPE numBuffers);                         /* out -- CDF's compressed cache buffers. */
                                           /* TYPE -- int* or "out int" */
```

CDFgetCompressionCacheSize gets the number of cache buffers used for the compression scratch CDF file. Refer to the CDF User's Guide for description of caching scheme used by the CDF library.

The arguments to CDFgetCompressionCacheSize are defined as follows:

Id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numBuffers	Number of cache buffers.

4.2.12.1. Example(s)

The following example returns the number of cache buffers used for the scratch file from the compressed CDF file.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numBuffers;      /* CDF's compression cache buffers. */
.
.
try {
    ....
    status = CDFgetCompressionCacheSize (id, &numBuffers);
    Or,
    Status = CDFgetCompressionCacheSize (id, out numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.2.13 CDFgetCompressionInfo

```
int CDFgetCompressionInfo (          /* out -- Completion status code. */
string CDFname,                    /* in -- CDF name. */
TYPE cType,                        /* out -- CDF compression type. */
TYPE2 cParms.                      /* out -- CDF compression parameters. */
TYPE3 cSize.                       /* out -- CDF compressed size. */
TYPE3 uSize);                     /* out -- CDF decompressed size. */
                                     /* TYPE -- int* or "out int" */
                                     /* TYPE2 -- int* or "out int[]" */
                                     /* TYPE3 -- long* or "out long" */
```

CDFgetCompressionInfo returns the compression type/parameters of a CDF without having to open the CDF. This refers to the compression of the CDF - not of any compressed variables.

The arguments to CDFgetCompressionInfo are defined as follows:

CDFname	The pathname of a CDF file without the .cdf file extension.
cType	The CDF compression type.
cParms	The CDF compression parameters.
cSize	The compressed CDF file size.
uSize	The size of CDF when decompress the originally compressed CDF.

4.2.13.1. Example(s)

The following example returns the compression information from a “unopen” CDF named “MY_TEST.cdf”.

```
.  
. .  
. .  
int status; /* Returned status code. */  
int cType; /* Compression type. */  
int[] cParms; /* Compression parameters. */  
long cSize; /* Compressed file size. */  
long uSize; /* Decompressed file size. */  
. .  
. .  
try {  
    ....  
    cParms = new int[1];  
    fixed (int* pcParms = cParms) {  
        status = CDFgetCompressionInfo(“MY_TEST”, &cType, pcParms, &cSize, &uSize);  
    }  
    Or,  
    status = CDFgetCompressionInfo(“MY_TEST”, out cType, out cParms, out cSize, out uSize);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.2.14 CDFgetCopyright

```
int CDFgetCopyright ( /* out -- Completion status code. */  
void* id, /* in -- CDF identifier. */  
out string copyright); /* out -- Copyright notice. */
```

CDFgetCopyright gets the Copyright notice in a CDF.

The arguments to CDFgetCopyright are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
Copyright	CDF Copyright.

4.2.14.1. Example(s)

The following example returns the Copyright in a CDF.

```
.  
.
```

```

.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    copyright;  /* CDF's copyright. */
.
.
try {
    ....
    status = CDFgetCopyright (id, out copyright);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.15 CDFgetDecoding

```

int CDFgetDecoding (          /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
TYPE decoding);           /* out -- CDF decoding. */
                          /* TYPE -- int* or "out int" */

```

CDFgetDecoding returns the decoding code for the data in a CDF. The decodings are described in Section 2.8.

The arguments to CDFgetDecoding are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
decoding	The decoding of the CDF.

4.2.15.1. Example(s)

The following example returns the decoding for the CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  decoding;        /* Decoding. */
.
.
try {
    ....
    status = CDFgetDecoding(id, &decoding);
    Or,
    status = CDFgetDecoding(id, out decoding);
    ...
    ...
}

```


CDFgetFileBackward returns the backward mode information dealing with the creation of a new CDF file. A mode of value 1 indicates when a new CDF file is created, it will be a backward version of V2.7, not the current library version.

The arguments to CDFgetFileBackward are defined as follows:

N/A

4.2.17.1. Example(s)

In the following example, the CDF's file backward mode is acquired.

```
.
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  mode;           /* Backward mode. */
.
.
try {
    ....
    mode = CDFgetFileBackward ();
    if(mode == BACKWARDFILEon) {
        .
    }
} catch (CDFException ex) {
    ...
}.

```

4.2.18 CDFgetFormat

```
int CDFgetFormat (          /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
TYPE format);           /* out -- CDF format. */
                          /* TYPE -- int* or "out int" */
```

CDFgetFormat returns the file format, single or multi-file, of the CDF. The formats are described in Section 2.5.

The arguments to CDFgetFormat are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
format	The format of the CDF.

4.2.18.1. Example(s)

The following example returns the file format of the CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  format;         /* Format. */
.
.
try {
    status = CDFgetFormat(id, &format);
    Or,
    status = CDFgetFormat(id, &format);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.2.19 CDFgetLeapSecondLastUpdated

```
int CDFgetLeapSecondLastUpdated (          /* out -- Completion status code. */
void* id,                                  /* in -- CDF identifier. */
TYPE lastUpdated);                       /* out -- Leap second last updated date. */
                                          /* TYPE -- int* or "out int" */
```

CDFgetLeapSecondLastUpdated returns the leap second last updated from the CDF. This value indicates what/if the leap second table this CDF is based on. It is of YYYYMMDD form. The value can also be negative 1 (-1), the field not set (for older CDFs), or zero (0) if the leap second table is not being accessed. This field is only relevant to TT2000 data in the CDF.

The arguments to CDFgetLeapSecondLastUpdated are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
lastUpdated	The date that the latest leap second was added to the leap second table.

4.2.19.1. Example(s)

The following example returns the date that the last leap second was added to the leap second table from the CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
```



```

int status; /* Returned status code. */
int lastUpdated; /* Date of the last updated. */
.
.
try {
    status = CDFgetLeapSecondLastUpdated (id, &lastUpdated);
    Or,
    status = CDFgetLeapSecondLastUpdated (id, out lastUpdated);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.20 CDFgetLibraryCopyright

```

int CDFgetLibraryCopyright ( /* out -- Completion status code. */
out String copyRight); /* out -- The copyright note. */

```

CDFgetLibraryCopyright returns the CDF copy right statements.

The arguments to CDFgetLeapSecondLastUpdated are defined as follows:

copyRight The copy right statements.

4.2.20.1. Example(s)

The following example returns the copy right note from the CDF library.

```

.
.
.
void* id; /* CDF identifier. */
int status; /* Returned status code. */
String copyRight; /* Copy right note. */
.
.
try {
    status = CDFgetLibraryCopyright (out copyRight);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.21 CDFgetLibraryVersion

```
int CDFgetLibraryVersion (                                /* out -- Completion status code. */
    TYPE version;                                       /* out -- The version of the library. */
    TYPE release;                                       /* out -- The release of the library. */
    TYPE increment;                                     /* out -- The increment of the library. */
    /* TYPE -- int* or "out int" */
    out string subIncrement);                          /* out -- The subincrement of the library. */
```

CDFgetLibraryVersion returns the CDF library version/release/increment/subincrement information.

The arguments to CDFgetLeapSecondLastUpdated are defined as follows:

version	The version
release	The release
increment	The increment
subincrement	The subincrement.

4.2.21.1. Example(s)

The following example returns the library version information from the CDF library.

```
.
.
.
void*    id;                                           /* CDF identifier. */
int      status;                                       /* Returned status code. */
int      version, release, increment;                 /* version/release/increment. */
string   subincrement;                                /* Copy right note. */
.
.
try {
    status = CDFgetLibraryVersion (&version, &release, &increment, out subincrement);
    or,
    status = CDFgetLibraryVersion (out version, out release, out increment, out subincrement);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
}
```

4.2.22 CDFgetMajority

```
int CDFgetMajority (                                /* out -- Completion status code. */
    void* id,                                         /* in -- CDF identifier. */
    TYPE majority);                                  /* out -- Variable majority. */
    /* TYPE -- int* or "out int" */
```

CDFgetMajority returns the variable majority, row or column-major, of the CDF. The majorities are described in Section 2.9.

The arguments to CDFgetMajority are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
majority	Variable majority of the CDF.

4.2.22.1. Example(s)

The following example returns the majority of the CDF.

```
.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  majority;        /* Majority. */
.
.
try {
    status = CDFgetMajority (id, &majority);
    Or,
    status = CDFgetMajority (id, out majority);

    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.2.23 CDFgetName

```
int CDFgetName (           /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
out string name);        /* out -- CDF name. */
```

CDFgetName returns the file name of the specified CDF.

The arguments to CDFgetName are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
name	The file name of the CDF.

4.2.23.1. Example(s)

The following example returns the name of the CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    name;       /* Name of the CDF. */
.
.
try {
    ....
    status = CDFgetName (id, out name);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.2.24 CDFgetNegtoPosfp0Mode

```
int CDFgetNegtoPosfp0Mode (          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
TYPE negtoPosfp0);                /* out -- -0.0 to 0.0 mode. */
                                     /* TYPE -- int* or "out int" */
```

CDFgetNegtoPosfp0Mode returns the -0.0 to 0.0 mode of the CDF. You can use CDFsetNegtoPosfp0 method to set the mode. The -0.0 to 0.0 modes are described in Section 2.16.

The arguments to CDFgetNegtoPosfp0Mode are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
negtoPosfp0	The -0.0 to 0.0 mode of the CDF.

4.2.24.1. Example(s)

The following example returns the -0.0 to 0.0 mode of the CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  negtoPosfp0;     /* -0.0 to 0.0 mode. */
.
.
```

```

.
try {
    ....
    status = CDFgetNegtoPosfp0Mode (id, &negtoPosfp0);
    Or,
    status = CDFgetNegtoPosfp0Mode (id, out negtoPosfp0);

    ...
    ....
} catch (CDFException ex) {
    ...
}.

```

4.2.25 CDFgetReadOnlyMode

```

int CDFgetReadOnlyMode(                                     /* out -- Completion status code. */
void* id,                                                  /* in -- CDF identifier. */
TYPE readOnlyMode);                                     /* out -- CDF read-only mode. */
                                                         /* TYPE -- int* or "out int" */

```

CDFgetReadOnlyMode returns the read-only mode for a CDF. You can use CDFsetReadOnlyMode to set the mode of readOnlyMode. The read-only modes are described in Section 2.14.

The arguments to CDFgetReadOnlyMode are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
readOnlyMode	The read-only mode (READONLYon or READONLYoff).

4.2.25.1. Example(s)

The following example returns the read-only mode for the given CDF.

```

.
.
.
void* id;                                                 /* CDF identifier. */
int readOnlyMode;                                       /* CDF read-only mode. */
.
.
try {
    ....
    status = CDFgetReadOnlyMode (id, &readOnlyMode);
    Or,
    status = CDFgetReadOnlyMode (id, out readOnlyMode);

    ...
    ...
} catch (CDFException ex) {

```

```
...
}.
```

4.2.26 CDFgetStageCacheSize

```
int CDFgetStageCacheSize(                                /* out -- Completion status code. */
void* id,                                                /* in -- CDF identifier. */
TYPE numBuffers);                                       /* out -- The stage cache size. */
                                                         /* TYPE -- int* or "out int" */
```

CDFgetStageCacheSize returns the number of cache buffers being used for the staging scratch file a CDF. Refer to the CDF User's Guide for the description of the caching scheme used by the CDF library.

The arguments to CDFgetStageCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numBuffers	Number of cache buffers.

4.2.26.1. Example(s)

The following example returns the number of cache buffers used in a CDF.

```
.
.
.
void* id;                                               /* CDF identifier. */
int numBuffers;                                         /* The number of cache buffers. */
.
.
try {
    ....
    status = CDFgetStageCacheSize (id, &numBuffers);
    Or,
    status = CDFgetStageCacheSize (id, out numBuffers);

    ...
    ...
.
} catch (CDFException ex) {
    ...
}.
}
```

4.2.27 CDFgetValidate

```
int CDFgetValidate(); /* out – CDF validation mode. */
```

CDFgetValidate returns the data validation mode. This information reflects whether when a CDF is open, its certain data fields are subjected to a validation process. 1 is returned if the data validation is to be performed, 0 otherwise.

The arguments to CDFgetVersion are defined as follows:

N/A

4.2.27.1. Example(s)

In the following example, it gets the data validation mode.

```
.  
. .  
void* id; /* CDF identifier. */  
int status; /* Returned status code. */  
int validate; /* Data validation flag. */  
. .  
try {  
    ....  
    validate = CDFgetValidate ();  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.2.28 CDFgetVersion

```
int CDFgetVersion( /* out -- Completion status code. */  
void* id, /* in -- CDF identifier. */  
TYPE version, /* out -- CDF version. */  
TYPE release, /* out -- CDF release. */  
TYPE increment); /* out -- CDF increment. */  
/* TYPE -- int* or "out int" */
```

CDFgetVersion returns the version/release information for a CDF file. This information reflects the CDF library that was used to create the CDF file.

The arguments to CDFgetVersion are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

version	The CDF version number.
release	The CDF release number.
increment	The CDF increment number.

4.2.28.1. Example(s)

In the following example, a CDF's version/release is acquired.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  version;        /* CDF version. */
int  release;       /* CDF release */
int  increment;     /* CDF increment. */
.
.
try {
    ....
    status = CDFgetVersion (id, &version, &release, &increment);
    Or,
    status = CDFgetVersion (id, out version, out release, out increment);
    ...
    ....
} catch (CDFException ex) {
    ...
}.

```

4.2.29 CDFgetzMode

```

int CDFgetzMode(          /* out -- Completion status code. */
void* id,                /* in -- CDF identifier. */
TYPE zMode);           /* out -- CDF zMode. */
                        /* TYPE -- int* or "out int" */

```

CDFgetzMode returns the zMode for a CDF file. The zModes are described in Section 2.15.

The arguments to CDFgetzMode are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
zMode	The CDF zMode.

4.2.29.1. Example(s)

In the following example, a CDF's zMode is acquired.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  zMode;          /* CDF zMode. */
.
.
try {
    ....
    status = CDFgetzMode (id, &zMode);
    Or,
    status = CDFgetzMode (id, out zMode);

    ...
    ...
} catch (CDFException ex) {
    ...
}.
}
```

4.2.30 CDFinquire

```
int CDFinquire(          /* out -- Completion status code. */
void* id,              /* in -- CDF identifier */
TYPE numDims,         /* out -- Number of dimensions, rVariables. */
TYPE2 dimSizes,      /* out -- Dimension sizes, rVariables. */
TYPE encoding,       /* out -- Data encoding. */
TYPE majority,      /* out -- Variable majority. */
TYPE maxRec,        /* out -- Maximum record number in the CDF, rVariables. */
TYPE numVars,       /* out -- Number of rVariables in the CDF. */
TYPE numAttrs);     /* out -- Number of attributes in the CDF. */
/* TYPE -- int* or "out int" */
/* TYPE2 -- int* or "out int[]" */
```

CDFinquire returns the basic characteristics of a CDF. An application needs to know the number of rVariable dimensions and their sizes before it can access rVariable data (since all rVariables' dimension and dimension size are the same). Knowing the variable majority can be used to optimize performance and is necessary to properly use the variable hyper functions (for both rVariables and zVariables).

The arguments to CDFinquire are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
numDims	Number of dimensions for the rVariables in the CDF.
dimSizes	Dimension sizes of the rVariables in the CDF. dimSizes is a 1-dimensional array containing one element per dimension. Each element of dimSizes receives the corresponding

	dimension size. For 0-dimensional rVariables this argument is ignored (but must be present).
encoding	The encoding of the variable data and attribute entry data. The encodings are defined in Section 2.7.
majority	The majority of the variable data. The majorities are defined in Section 2.9.
maxRec	Maximum record number written to an rVariable in the CDF. Note that the maximum record number written is also kept separately for each rVariable in the CDF. The value of maxRec is the largest of these. Some rVariables may have fewer records actually written. Use CDFrVarMaxWrittenRecNum to inquire the maximum record written for an individual rVariable.
numVars	Number of rVariables in the CDF.
numAttr	Number of attributes in the CDF.

4.2.30.1. Example(s)

The following example returns the basic information about a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numDims;        /* Number of dimensions, rVariables. */
int[] dimSizes;      /* Dimension sizes, rVariables (allocate to
allow the
                        allow the maximum # of dimensions). */
int  encoding;       /* Data encoding. */
int  majority;       /* Variable majority. */
int  maxRec;         /* Maximum record number, rVariables. */
int  numVars;        /* Number of rVariables in CDF. */
int  numAttr;       /* Number of attributes in CDF. */
.
.
try {
    ....
    dimSizes = new int[CDF_MAX_DIMS];
    fixed (int* pdimSizes = dimSizes) {
        status = CDFinquire (id, &numDims, pdimSizes, &encoding, &majority,
                            &maxRec, &numVars, &numAttr);
    }
    Or,
    status = CDFinquire (id, out numDims, out dimSizes, out encoding, out majority,
                        out maxRec, out numVars, out numAttr);
.
} catch (CDFException ex) {
    ...
}.

```

4.2.31 CDFinquireCDF

```
int CDFinquireCDF(                                /* out -- Completion status code. */
void* id,                                         /* in -- CDF identifier */
TYPE numDims,                                    /* out -- Number of dimensions for rVariables. */
TYPE2 dimSizes,                                 /* out -- Dimension sizes for rVariables. */
TYPE encoding,                                  /* out -- Data encoding. */
TYPE majority,                                  /* out -- Variable majority. */
TYPE maxrRec,                                   /* out -- Maximum record number among rVariables in the CDF. */
TYPE numrVars,                                  /* out -- Number of rVariables in the CDF. */
TYPE maxzRec,                                   /* out -- Maximum record number among zVariables in the CDF. */
TYPE numzVars,                                  /* out -- Number of zVariables in the CDF. */
TYPE numAttrs;                                  /* out -- Number of attributes in the CDF. */
                                                /* TYPE -- int* or "out int" */
                                                /* TYPE2 -- int* or "out int[]" */
```

CDFinquireCDF returns the basic characteristics of a CDF. This method expands the method CDFinquire by acquiring extra information regarding the zVariables. Knowing the variable majority can be used to optimize performance and is necessary to properly use the variable hyper-get/put functions.

The arguments to CDFinquireCDF are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numDims	Number of dimensions for the rVariables in the CDF. Note that all the rVariables' dimensionality in the same CDF file must be the same.
dimSizes	Dimension sizes of the rVariables in the CDF (note that all the rVariables' dimension sizes in the same CDF file must be the same). dimSizes is a 1-dimensional array containing one element per dimension. Each element of dimSizes receives the corresponding dimension size. For 0-dimensional rVariables this argument is ignored (but must be present).
encoding	The encoding of the variable data and attribute entry data. The encodings are defined in Section 2.7.
majority	The majority of the variable data. The majorities are defined in Section 2.9.
maxrRec	Maximum record number written to an rVariable in the CDF. Note that the maximum record number written is also kept separately for each rVariable in the CDF. The value of maxRec is the largest of these.
numrVars	Number of rVariables in the CDF.
maxzRec	Maximum record number written to a zVariable in the CDF. Note that the maximum record number written is also kept separately for each zVariable in the CDF. The value of maxRec is the largest of these. Some zVariables may have fewer records than actually written. Use CDFgetzVarMaxWrittenRecNum to inquire the actual number of records written for an individual zVariable.
numzVars	Number of zVariables in the CDF.

numAttrs Number of attributes in the CDF.

4.2.31.1. Example(s)

The following example returns the basic information about a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numDims;        /* Number of dimensions, rVariables. */
int[] dimSizes;      /* Dimension sizes, rVariables (allocate to
                    /* allow the maximum # of dimensions). */

int  encoding;       /* Data encoding. */
int  majority;      /* Variable majority. */
int  maxrRec;       /* Maximum record number, rVariables. */
int  numrVars;      /* Number of rVariables in CDF. */
int  maxzRec;       /* Maximum record number, zVariables. */
int  numzVars;      /* Number of zVariables in CDF. */
int  numAttrs;      /* Number of attributes in CDF. */

.
.
try {
    dimSizes = new int[CDF_MAX_DIMS];
    fixed (int* pdimSizes = dimSizes) {
        status = CDFinquireCDF (id, &numDims, pdimSizes, &encoding, &majority,
                                &maxrRec, &numrVars, &maxzRec, &numzVars, &numAttrs);
    }
}
Or,
    status = CDFinquireCDF (id, out numDims, out dimSizes, out encoding, out majority,
                            out maxrRec, out numrVars, out maxzRec, out numzVars, out numAttrs);

...
...
} catch (CDFException ex) {
    ...
}.

```

4.2.32 CDFopen

```
int CDFopen(          /* out -- Completion status code. */
string CDFname,      /* in -- CDF file name. */
void* *id);          /* out -- CDF identifier. */
```

CDFopen, a legacy CDF function, opens an existing CDF. The CDF is initially opened with only read access. This allows multiple applications to read the same CDF simultaneously. When an attempt to modify the CDF is made, it is automatically closed and reopened with read/write access. (The method will fail if the application does not have or cannot get write access to the CDF.)

The arguments to CDFopen are defined as follows:

CDFname The file name of the CDF to open. (Do not specify an extension.) This may be at most CDF_PATHNAME_LEN characters. A CDF file name may contain disk and directory specifications that conform to the conventions of the operating system being used (including logical names on OpenVMS systems and environment variables on UNIX systems).

UNIX: File names are case-sensitive.

id Identifier for the opened CDF. This identifier must be used in all subsequent operations on the CDF.

NOTE: CDFclose must be used to close the CDF before your application exits to ensure that the CDF will be correctly written to disk.

4.2.32.1. Example(s)

The following example will open a CDF named "NOAA1.cdf".

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string     CDFname = "NOAA1"; /* file name of CDF. */
.
.
try {
    status = CDFopen (CDFname, &id);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.2.33 CDFopenCDF

```
int CDFopenCDF(          /* out -- Completion status code. */
string CDFname,         /* in -- CDF file name. */
void* *id);            /* out -- CDF identifier. */
```

CDFopenCDF opens an existing CDF. This method is identical to CDFopen, and the use of this method is strongly encouraged over CDFopen as it might not be supported in the future. The CDF is initially opened with only read access. This allows multiple applications to read the same CDF simultaneously. When an attempt to modify the CDF is made, it is automatically closed and reopened with read/write access. The method will fail if the application does not have or cannot get write access to the CDF.

The arguments to CDFopenCDF are defined as follows:

CDFname The file name of the CDF to open. (Do not specify an extension.) This may be at most CDF_PATHNAME_LEN characters. A CDF file name may contain disk and directory specifications that conform to the conventions of the operating system being used (including logical names on OpenVMS systems and environment variables on UNIX systems).

UNIX: File names are case-sensitive.

id Identifier for the opened CDF. This identifier must be used in all subsequent operations on the CDF.

NOTE: CDFcloseCDF must be used to close the CDF before your application exits to ensure that the CDF will be correctly written to disk.

4.2.33.1. Example(s)

The following example will open a CDF named "NOAA1.cdf".

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    CDFname = "NOAA1"; /* file name of CDF. */
.
.
try {
    ....
    status = CDFopenCDF (CDFname, &id);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.2.34 CDFselect

```
int CDFselect(          /* out -- Completion status code. */
void* id);             /* in -- CDF identifier. */
```

CDFselect selects an opened CDF as the current CDF. Only one CDF is allowed to be current. To access data from a CDF, that CDF must be selected as the current. This method is no longer needed as the methods involved CDF operations always need the CDF identifier, as the first argument, so it can be set as current before other operations can be applied.

The arguments to CDFselect are defined as follows:

id Identifier for the opened CDF. This identifier must be used in all subsequent operations on the CDF.

NOTE: When a CDF is opened, it becomes the current. No CDF is current after CDFcloseCDF is called to close the file.

4.2.34.1. Example(s)

The following example will select a CDF named “NOAA1.cdf” as the current CDF while another file “NOAA2.cdf” is also opened.

```
.
.
.
void*      id1, id2;          /* CDF identifier. */
int  status;                 /* Returned status code. */
string    CDFname1 = "NOAA1"; /* file name of CDF. */
string    CDFname2 = "NOAA2"; /* file name of CDF. */
.
try {
    ....
    status = CDFopenCDF (CDFname1, &id1);

    status = CDFopenCDF (CDFname2, &id2);

    status = CDFselect(id1);
    ....
    status = CDFclose(id1);
    status = CDFclose(id2);
} catch (CDFException ex) {
    ...
}...
```

4.2.35 CDFselectCDF

```
int CDFselectCDF(          /* out -- Completion status code. */
void* id);                /* in -- CDF identifier. */
```

CDFselectCDF selects an opened CDF as the current CDF. Only one CDF is allowed to be current. To access data from a CDF, that CDF must be selected as the current. This method is no longer needed as the methods involved CDF operations always need the CDF identifier, as the first argument, so it can be set as current before other operations can be applied. This method is identical to CDFselect.

The arguments to CDFselectCDF are defined as follows:

id Identifier for the opened CDF. This identifier must be used in all subsequent operations on the CDF.

NOTE: When a CDF is opened, it becomes the current. No CDF is current after CDFcloseCDF is called to close the file.

4.2.35.1. Example(s)

The following example will select a CDF named “NOAA1.cdf” as the current CDF while another file “NOAA2.cdf” is also opened.

```
.
.
.
void*      id1, id2;          /* CDF identifier. */
int  status;                /* Returned status code. */
string    CDFname1 = "NOAA1"; /* file name of CDF. */
string    CDFname2 = "NOAA2"; /* file name of CDF. */
.
try {
    ....
    status = CDFopenCDF (CDFname1, &id1);

    status = CDFopenCDF (CDFname2, &id2);

    status = CDFselectCDF(id1);
    ....
    status = CDFclose(id1);
    status = CDFclose(id2);
} catch (CDFException ex) {
    ...
}...
```

4.2.36 CDFsetCacheSize

```
int CDFsetCacheSize (          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int numBuffers);             /* in -- CDF's cache buffers. */
```

CDFsetCacheSize specifies the number of cache buffers being used for the dotCDF file when a CDF is open. Refer to the CDF User’s Guide for the description of the cache scheme used by the CDF library.

The arguments to CDFsetCacheSize are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

numBuffers Number of cache buffers.

4.2.36.1. Example(s)

The following example extends the number of cache buffers to 500 for the open CDF file. The default number is 300 for a single-file format CDF on Unix systems.

```
.
```



```

.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  cacheBuffers;    /* CDF's cache buffers. */
.
.
cacheBuffers = 500;
try {
    ....
    status = CDFsetCacheSize (id, cacheBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.37 CDFsetChecksum

```

int CDFsetChecksum (          /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
int checksum);              /* in -- CDF's checksum mode. */

```

CDFsetChecksum specifies the checksum mode for the CDF. The CDF checksum mode is described in Section 2.20.

The arguments to CDFsetChecksum are defined as follows:

- id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
- checksum The checksum mode (NO_CHECKSUM or MD5_CHECKSUM).

4.2.37.1. Example(s)

The following example turns off the checksum flag for the open CDF file..

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  checksum;        /* CDF's checksum. */
.
.
checksum= NO_CHECKSUM;
try {
    ....
    status = CDFsetChecksum (id, checksum);
    ...
    ...
}

```

```

} catch (CDFException ex) {
    ...
}.

```

4.2.38 CDFsetCompression

```

int CDFsetCompression (
void* id,
int compressionType,
TYPE compressionParms);

```

/ out -- Completion status code. */*
/ in -- CDF identifier. */*
/ in -- CDF's compression type. */*
/ in -- CDF's compression parameters. */*
/ **TYPE** -- int* or int[] */*

CDFsetCompression specifies the compression type and parameters for a CDF. This compression refers to the CDF, not of any variables. The compressions are described in Section 2.11.

The arguments to CDFsetCompression are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
compressionType	The compression type .
compressionParms	The compression parameters.

4.2.38.1. Example(s)

The following example uses GZIP.6 to compress the CDF file.

```

.
.
.
void*      id;
int  status;
int  compressionType;
int[] compressionParms = new int[1]

```

/ CDF identifier. */*
/ Returned status code. */*
/ CDF's compression type. */*
/ CDF's compression parameters. */*

```

.
.
compressionType = GZIP_COMPRESSION;
compressionParms[0] = 6;
try {
    ....
    fixed(int* pcompressionParms = compressionParms) {
        status = CDFsetCompression (id, compressionType, pcompressionParms);
    }
}
Or,
status = CDFsetCompression (id, compressionType, compressionParms); ...
...
} catch (CDFException ex) {
    ...
}.

```

4.2.39 CDFsetCompressionCacheSize

```
int CDFsetCompressionCacheSize (          /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
int compressionNumBuffers);             /* in -- CDF's compressed cache buffers. */
```

CDFsetCompressionCacheSize specifies the number of cache buffers used for the compression scratch CDF file. Refer to the CDF User's Guide for the description of the cache scheme used by the CDF library.

The arguments to CDFsetCompressionCacheSize are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
compressionNumBuffers	Number of cache buffers.

4.2.39.1. Example(s)

The following example extends the number of cache buffers used for the scratch file from the compressed CDF file to 100. The default cache buffers is 80 for Unix systems.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  compressionNumBuffers; /* CDF's compression cache buffers. */
.
.
compressionNumBuffers = 100;
try {
    ....
    status = CDFsetCompressionCacheSize (id, compressionNumBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
}
```

4.2.40 CDFsetDecoding

```
int CDFsetDecoding (          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int decoding);              /* in -- CDF decoding. */
```

CDFsetDecoding sets the decoding of a CDF. The decodings are described in Section 2.8.

The arguments to CDFsetDecoding are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
decoding	The decoding of a CDF.

4.2.40.1. Example(s)

The following example sets NETWORK_DECODING to be the decoding scheme in the CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  decoding;        /* Decoding. */
.
.
decoding = NETWORK_DECODING;
try {
    ....
    status = CDFsetDecoding (id, decoding);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.41 CDFsetEncoding

```
int CDFsetEncoding (          /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
int encoding);              /* in -- CDF encoding. */
```

CDFsetEncoding specifies the data encoding of the CDF. A CDF's encoding may not be changed after any variable values have been written. The encodings are described in Section 2.7.

The arguments to CDFsetEncoding are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
encoding	The encoding of the CDF.

4.2.41.1. Example(s)

The following example sets the encoding to HOST_ENCODING for the CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  status;          /* Returned status code. */  
int  encoding;        /* Encoding. */  
. .  
encoding = HOST_ENCODING;  
try {  
    status = CDFsetEncoding(id, encoding);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.2.42 CDFsetFileBackward

```
void CDFsetFileBackward(  
int mode)                /* in -- File backward Mode. */
```

CDFsetFileBackward sets the backward mode. When the mode is set as BACKWARDFILEon, any new CDF files created are of version 2.7, instead of the underlining library version. If mode BACKWARDFILEoff is used, the default for creating new CDF files, the library version is the version of the file.

The arguments to CDFsetFileBackward are defined as follows:

mode	The backward mode.
------	--------------------

4.2.42.1. Example(s)

In the following example, it sets the file backward mode to BACKWARDFILEoff, which means that any files to be created will be of version V3.*, the same as the library version.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  status;          /* Returned status code. */  
. .  
try {
```

```

.....
CDFsetFileBackward (BACKWARDFILEoff);
...
...
} catch (CDFException ex) {
...
}.
.

```

4.2.43 CDFsetFormat

```

int CDFsetFormat (                               /* out -- Completion status code. */
void* id,                                       /* in -- CDF identifier. */
int format);                                   /* in -- CDF format. */

```

CDFsetFormat specifies the file format, either single or multi-file format, of the CDF. A CDF's format may not be changed after any variable values have been written. The formats are described in Section 2.5.

The arguments to CDFsetFormat are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
format	The file format of the CDF.

4.2.43.1. Example(s)

The following example sets the file format to MULTI_FILE for the CDF. The default is SINGLE_FILE format.

```

.
.
.
void*      id;                                /* CDF identifier. */
int  status;                                /* Returned status code. */
int  format;                                /* Format. */
.
.
format = MULTI_FILE;
try {
.....
    status = CDFsetFormat(id, format);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.

```

4.2.44 CDFsetLeapSecondLastUpdated

```
int CDFsetLeapSecondLastUpdated (          /* out -- Completion status code. */
void* id,                                  /* in -- CDF identifier. */
int lastUpdated);                          /* in -- CDF format. */
```

CDFsetLeapSecondLastUpdated respecifies the date that the leap second was last updated in the CDF. The date, in YYYYMMDD form, has to be either a valid entry in the currently used leap second table, or zero (0). This function is called usually for older CDFs that have not had that information set. This field is onlt relevant to TT2000 data in a CDF.

The arguments to CDFsetLeapSecondLastUpdated are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
lastUpdated	The leap second last updated date.

4.2.44.1. Example(s)

The following example resets the the leap second last updated date to 20150701 in the CDF. The field might not be set (an older CDF).

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  lastUpdated;     /* The last date the leap second was updated. */
.
.
lastUpdated = 20150701;
try {
    ....
    status = CDFsetLeapSecondLastUpdated (id, lastUpdated);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
}
```

4.2.45 CDFsetMajority

```
int CDFsetMajority (          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int majority);               /* in -- CDF variable majority. */
```

CDFsetMajority specifies the variable majority, either row or column-major, of the CDF. A CDF's majority may not be changed after any variable values have been written. The majorities are described in Section 2.9.

The arguments to CDFsetMajority are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
majority	Variable majority of the CDF.

4.2.45.1. Example(s)

The following example sets the majority to COLUMN_MAJOR for the CDF. The default is ROW_MAJOR.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  majority;        /* Majority. */
.
.
majority = COLUMN_MAJOR;
try {
    ....
    status = CDFsetMajority (id, majority);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.46 CDFsetNegtoPosfp0Mode

```

int CDFsetNegtoPosfp0Mode (          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int negtoPosfp0);                  /* in -- -0.0 to 0.0 mode. */

```

CDFsetNegtoPosfp0Mode specifies the -0.0 to 0.0 mode of the CDF. The -0.0 to 0.0 modes are described in Section 2.16.

The arguments to CDFsetNegtoPosfp0Mode are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
negtoPosfp0	The -0.0 to 0.0 mode of the CDF.

4.2.46.1. Example(s)

The following example sets the -0.0 to 0.0 mode to ON for the CDF.


```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  negtoPosfp0;     /* -0.0 to 0.0 mode. */
.
.
negtoPosfp0 = NEGtoPOSfp0on;
try {
    ....
    status = CDFsetNegtoPosfp0Mode (id, negtoPosfp0);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.47 CDFsetReadOnlyMode

```

int CDFsetReadOnlyMode(          /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
int  readOnlyMode);            /* in -- CDF read-only mode. */

```

CDFsetReadOnlyMode specifies the read-only mode for a CDF. The read-only modes are described in Section 2.14.

The arguments to CDFsetReadOnlyMode are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
readOnlyMode	The read-only mode.

4.2.47.1. Example(s)

The following example sets the read-only mode to OFF for the CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  readMode;        /* CDF read-only mode. */
.
.
readMode = READONLYoff;
try {
    ....
    status = CDFsetReadOnlyMode (id, readMode);
    ...
    ...
}

```

```

} catch (CDFException ex) {
    ...
}.

```

4.2.48 CDFsetStageCacheSize

```

int CDFsetStageCacheSize(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int numBuffers);                  /* in -- The stage cache size. */

```

CDFsetStageCacheSize specifies the number of cache buffers being used for the staging scratch file a CDF. Refer to the CDF User's Guide for the description of the caching scheme used by the CDF library.

The arguments to CDFsetStageCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numBuffers	Number of cache buffers.

4.2.48.1. Example(s)

The following example sets the number of stage cache buffers to 10 for a CDF.

```

.
.
.
void* id;                          /* CDF identifier. */
int numBuffers;                    /* The number of cache buffers. */
.
.
numBuffers = 10;
try {
    ....
    status = CDFsetStageCacheSize (id, numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.2.49 CDFsetValidate

```
void CDFsetValidate(  
int mode); /* in -- File Validation Mode. */
```

CDFsetValidate sets the data validation mode. The validation mode dedicates whether certain data in an open CDF file will be validated. This mode should be set before the any files are opened. Refer to Data Validation Section 2.21.

The arguments to CDFsetValidate are defined as follows:

mode	The validation mode.
------	----------------------

4.2.49.1. Example(s)

In the following example, it sets the validation mode to be on, so any following CDF files are subjected to the data validation process when they are open.

```
.  
. .  
. .  
try {  
    ....  
    CDFsetValidate (VALIDATEFILEon);  
    ...  
} catch (CDFException ex) {  
    ...  
}
```

4.2.50 CDFsetzMode

```
int CDFsetzMode( /* out -- Completion status code. */  
void* id, /* in -- CDF identifier. */  
int zMode); /* in -- CDF zMode. */
```

CDFsetzMode specifies the zMode for a CDF file. The zModes are described in Section 2.15 and see the Concepts chapter in the CDF User's Guide for a more detailed information on zModes. zMode is used when dealing with a CDF file that contains 1) rVariables, or 2) rVariables and zVariables. If you want to treat rVariables as zVariables, it's highly recommended to set the value of zMode to zMODEon2.

The arguments to CDFsetzMode are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
zMode	The CDF zMode.

4.2.50.1. Example(s)

In the following example, a CDF's zMode is specified to zMODEon2: all rVariables are treated as zVariables with NOVARY dimensions being eliminated.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  zMode;          /* CDF zMode. */
.
.
zMode = zMODEon2;
try {
    ....
    status = CDFsetzMode (id, zMode);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3 Variables

The methods in this section are all CDF variable-specific. A variable, either a rVariable or zVariable, is identified by its unique name in a CDF or a variable number. Before you can perform any operation on a variable, the CDF in which it resides in must be opened.

4.3.1 CDFcloserVar

```

int CDFcloserVar(          /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
int varNum)              /* in -- rVariable number. */

```

CDFcloserVar closes the specified rVariable file from a multi-file format CDF. Note that rVariables in a single-file CDF don't need to be closed. The variable's cache buffers are flushed before the variable's open file is closed. However, the CDF file is still open.

NOTE: For the multi-file CDF, you must close all open variable files to guarantee that all modifications you have made will actually be written to the CDF's file(s). If your program exits, normally or otherwise, without a successful call to CDFcloseCDF, the CDF's cache buffers are left unflushed.

The arguments to CDFcloserVar are defined as follows:

- id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
- varNum Variable number for the open rVariable's file. This identifier must have been initialized by a call to CDFcreaterVar or CDFgetVarNum.

4.3.1.1. Example(s)

The following example will close an open rVariable file from a multi-file CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;         /* rVariable number. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "VAR_NAME1");
    .
    status = CDFclosezVar (id, varNum);
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.2 CDFclosezVar

```
int CDFclosezVar(          /* out -- Completion status code. */
void* id,                /* in -- CDF identifier. */
int varNum)              /* in -- zVariable number. */
```

CDFclosezVar closes the specified zVariable file from a multi-file format CDF. Note that zVariables in a single-file CDF don't need to be closed. The variable's cache buffers are flushed before the variable's open file is closed. However, the CDF file is still open.

NOTE: For the multi-file CDF, you must close all open variable files to guarantee that all modifications you have made will actually be written to the CDF's file(s). If your program exits, normally or otherwise, without a successful call to CDFcloseCDF, the CDF's cache buffers are left unflushed.

The arguments to CDFclosezVar are defined as follows:

- id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

- varNum Variable number for the open zVariable's file. This identifier must have been initialized by a call to CDFcreatezVar or CDFgetVarNum.

4.3.2.1. Example(s)

The following example will close an open zVariable file from a multi-file CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;         /* zVariable number. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "VAR_NAME1");
    .
    status = CDFclosezVar (id, varNum);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.3 CDFconfirmrVarExistence

```

int CDFconfirmrVarExistence(          /* out -- Completion status code. */
void* id,                            /* in -- CDF identifier. */
string varName);                    /* in -- rVariable name. */

```

CDFconfirmrVarExistence confirms the existence of a rVariable with a given name in a CDF. If the rVariable does not exist, an error code will be returned. No exception is thrown if the variable is not found.

The arguments to CDFconfirmrEntryExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

varName rVariable name to check.

4.3.3.1. Example(s)

The following example checks the existence of rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFconfirmrVarExistence (id, "MY_VAR");
    if (status != CDF_OK) UserStatusHandler (status);
    ...
}

```

```

...
} catch (CDFException ex) {
...
}.

```

4.3.4 CDFconfirmrVarPadValueExistence

```

int CDFconfirmrVarPadValueExistence(          /* out -- Completion status code. */
void* id,                                     /* in -- CDF identifier. */
int varNum)                                  /* in -- rVariable number. */

```

CDFconfirmrVarPadValueExistence confirms the existence of an explicitly specified pad value for the specified rVariable in a CDF. If an explicit pad value has not been specified, the informational status code NO_PADVALUE_SPECIFIED will be returned. No exception is thrown if the variable's pad value is not defined.

The arguments to CDFconfirmrVarPadValueExistence are defined as follows:

- id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
- varNum rVariable number.

4.3.4.1. Example(s)

The following example checks the existence of the pad value of rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;          /* rVariable number. */
.
.
try {
....
varNum = CDFgetVarNum(id, "MY_VAR");
status = CDFconfirmrVarPadValueExistence (id, varNum);
if (status != NO_PADVALUE_SPECIFIED) {
.
}
...
...
} catch (CDFException ex) {
...
}.

```

4.3.5 CDFconfirmzVarExistence

```
int CDFconfirmzVarExistence(           /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
string varName);                      /* in -- zVariable name. */
```

CDFconfirmzVarExistence confirms the existence of a zVariable with a given name in a CDF. If the zVariable does not exist, an error code will be returned. No exception is thrown if the variable is not found.

The arguments to CDFconfirmEntryExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

varName zVariable name to check.

4.3.5.1. Example(s)

The following example checks the existence of zVariable “MY_VAR” in a CDF.

```
.
.
.
void*        id;                        /* CDF identifier. */
int    status;                         /* Returned status code. */
.
.
try {
    ....
    status = CDFconfirmzVarExistence (id, “MY_VAR”);
    if (status != CDF_OK) UserStatusHandler (status);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.6 CDFconfirmzVarPadValueExistence

```
int CDFconfirmzVarPadValueExistence( /* out -- Completion status code. */
void* id,                            /* in -- CDF identifier. */
int varNum)                         /* in -- zVariable number. */
```

CDFconfirmzVarPadValueExistence confirms the existence of an explicitly specified pad value for the specified zVariable in a CDF. If an explicit pad value has not been specified, the informational status code NO_PADVALUE_SPECIFIED will be returned. No exception is thrown if the variable’s pad value is not defined.

The arguments to CDFconfirmzVarPadValueExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

varNum zVariable number.

4.3.6.1. Example(s)

The following example checks the existence of the pad value of zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;          /* zVariable number. */
.
.
try {
    ....
    varNum = CDFgetVarNum(id, "MY_VAR");
    status = CDFconfirmzVarPadValueExistence (id, varNum);
    if (status != NO_PADVALUE_SPECIFIED) {
.
    }
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.7 CDFcreatorVar

```

int CDFcreatorVar(          /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
string varName,           /* in -- rVariable name. */
int dataType,            /* in -- Data type. */
int numElements,         /* in -- Number of elements (of the data type). */
int recVariance,         /* in -- Record variance. */
int[] dimVariances,      /* in -- Dimension variances. */
TYPE varNum);           /* out -- rVariable number. */
                          /* TYPE -- int* or "out int" */

```

CDFcreatorVar is used to create a new rVariable in a CDF. A variable (rVariable or rVariable) with the same name must not already exist in the CDF.

The arguments to CDFcreatorVar are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.


```

Or,
status = CDFcreatorVar (id, "EPOCH", CDF_EPOCH, 1, EPOCHrecVary,
                       EPOCHdimVarys, out EPOCHvarNum);
status = CDFcreatorVar (id, "LATITUDE", CDF_INT2, 1, LATrecVary, LATdimVarys,
                       out LATvarNum);
status = CDFcreatorVar (id, "INTITUDE", CDF_INT2, 1, LONrecVary, LONdimVarys,
                       out LONvarNum);
status = CDFcreatorVar (id, "TEMPERATURE", CDF_REAL4, 1, TMPrecVary,
                       TMPdimVarys, out TMPvarNum);

.
} catch (CDFException ex) {
    ...
}.

```

4.3.8 CDFcreatezVar

```

int CDFcreatezVar(                                     /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
string varName,                                       /* in -- zVariable name. */
int dataType,                                        /* in -- Data type. */
int numElements,                                     /* in -- Number of elements (of the data type). */
int numDims,                                         /* in -- Number of dimensions. */
int[] dimSizes,                                      /* in -- Dimension sizes */
int recVariance,                                     /* in -- Record variance. */
int[] dimVariances,                                  /* in -- Dimension variances. */
TYPE varNum);                                       /* out -- zVariable number. */
/* TYPE -- int* or "out int" */

```

CDFcreatezVar is used to create a new zVariable in a CDF. A variable (rVariable or zVariable) with the same name must not already exist in the CDF.

The arguments to CDFcreatezVar are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varName	The name of the zVariable to create. This may be at most CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.
dataType	Data type of the new zVariable. Specify one of the data types defined in Section 2.6.
numElements	Number of elements of the data type at each value. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string (each value consists of the entire string). For all other data types this must always be one (1) - multiple elements at each value are not allowed for non-character data types.
numDims	Number of dimensions the zVariable. This may be as few as zero (0) and at most CDF_MAX_DIMS.

dimSizes	The size of each dimension. Each element of dimSizes specifies the corresponding dimension size. Each size must be greater than zero (0). For 0-dimensional zVariables this argument is ignored (but must be present).
recVariance	zVariable's record variance. Specify one of the variances defined in Section 2.10.
dimVariances	zVariable's dimension variances. Each element of dimVariances specifies the corresponding dimension variance. For each dimension specify one of the variances defined in Section 2.10. For 0-dimensional zVariables this argument is ignored (but must be present).
varNum	The number assigned to the new zVariable. This number must be used in subsequent CDF function calls when referring to this zVariable. An existing zVariable's number may be determined with the CDFgetVarNum function.

4.3.8.1. Example(s)

The following example will create several zVariables in a CDF. In this case EPOCH is a 0-dimensional, LAT and LON are 2-dimensional, and TMP is a 1-dimensional.

```

.
.
.
void*      id;                /* CDF identifier. */
int  status;                 /* Returned status code. */
int  EPOCHrecVary = VARY;    /* EPOCH record variance. */
int  LATrecVary = NOVARY;    /* LAT record variance. */
int  LONrecVary = NOVARY;    /* LON record variance. */
int  TMPrecVary = VARY;      /* TMP record variance. */
int[] EPOCHdimVarys = new int[] {NOVARY}; /* EPOCH dimension variances. */
int[] LATdimVarys = new int[] {VARY,VARY}; /* LAT dimension variances. */
int[] LONdimVarys = new int[] {VARY,VARY}; /* LON dimension variances. */
int[] TMPdimVarys = new int[] {VARY,VARY}; /* TMP dimension variances. */
int  EPOCHvarNum;           /* EPOCH zVariable number. */
int  LATvarNum;             /* LAT zVariable number. */
int  LONvarNum;            /* LON zVariable number. */
int  TMPvarNum;            /* TMP zVariable number. */
int[] EPOCHdimSizes = new int[] {3};      /* EPOCH dimension sizes. */
int[] LATLONdimSizes = new int[] {2,3}    /* LAT/LON dimension sizes. */
int[] TMPdimSizes = new int[] {3};        /* TMP dimension sizes. */
.
.
try {
    status = CDFcreatezVar (id, "EPOCH", CDF_EPOCH, 1, 0, EPOCHdimSizes, EPOCHrecVary,
                           EPOCHdimVarys, &EPOCHvarNum);
    status = CDFcreatezVar (id, "LATITUDE", CDF_INT2, 1, 2, LATLONdimSizes, LATrecVary, LATdimVarys,
                           &LATvarNum);
    status = CDFcreatezVar (id, "INTITUDE", CDF_INT2, 1, 2, LATLONdimSizes, LONrecVary, LONdimVarys,
                           &LONvarNum);
    status = CDFcreatezVar (id, "TEMPERATURE", CDF_REAL4, 1, 1, TMPdimSizes, TMPrecVary,
                           TMPdimVarys, &TMPvarNum);

```

Or,


```
    }.
```

4.3.10 CDFdeleterVarRecords

```
int CDFdeleterVarRecords(          /* out -- Completion status code. */  
void* id,                        /* in -- CDF identifier. */  
int varNum,                      /* in -- rVariable identifier. */  
int startRec,                   /* in -- Starting record number. */  
int endRec);                   /* in -- Ending record number. */
```

CDFdeleterVarRecords deletes a range of data records from the specified rVariable in a CDF.

The arguments to CDFdeleterVarRecords are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
startRec	Starting record number to delete.
endRec	Ending record number to delete.

4.3.10.1. Example(s)

The following example deletes 11 records (from record numbered 11 to 21) from the rVariable “MY_VAR” in a CDF. Note: The first record is numbered as 0.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  status;          /* Returned status code. */  
int  varNum;         /* rVariable number. */  
int  startRec;      /* Starting record number. */  
int  endRec;       /* Ending record number. */  
. .  
try {  
    ....  
    varNum = CDFgetVarNum (id, “MY_VAR”);  
    startRec = 10;  
    endRec = 20;  
    status = CDFdeleterVarRecords (id, varNum, startRec, endRec);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.
```


CDFdeletezVarRecords deletes a range of data records from the specified zVariable in a CDF. If this is a variable with sparse records, the remaining records after deletion will not be renumbered.⁹

The arguments to CDFdeletezVarRecords are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
startRec	Starting record number to delete.
endRec	Ending record number to delete.

4.3.12.1. Example(s)

The following example deletes 11 records (from record numbered 11 to 21) from the zVariable “MY_VAR” in a CDF. Note: The first record is numbered as 0.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;         /* zVariable number. */
int  startRec;       /* Starting record number. */
int  endRec;        /* Ending record number. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    startRec = 10;
    endRec = 20;
    status = CDFdeletezVarRecords (id, varNum, startRec, endRec);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.13 CDFdeletezVarRecordsRenumber

```
int CDFdeletezVarRecordsRenumber(          /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
int  varNum,                             /* in -- zVariable identifier. */
int  startRec,                           /* in -- Starting record number. */
```

⁹ Normal variables without sparse records have contiguous physical records. Once a section of the records get deleted, the remaining ones automatically fill the gap.


```
int endRec); /* in -- Ending record number. */
```

CDFdeletezVarRecordsRenummer deletes a range of data records from the specified zVariable in a CDF. If this is a variable with sparse records, the remaining records after deletion will be renumbered, just like non-sparse variable's records.

The arguments to CDFdeletezVarRecordsRenummer are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
startRec	Starting record number to delete.
endRec	Ending record number to delete.

4.3.13.1. Example(s)

The following example deletes 11 records (from record numbered 11 to 21) from the zVariable "MY_VAR" in a CDF. Note: The first record is numbered as 0. If the last record number is 100, then after the deletion, the record will be 89.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  varNum;         /* zVariable number. */
int  startRec;       /* Starting record number. */
int  endRec;        /* Ending record number. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    startRec = 10;
    endRec = 20;
    status = CDFdeletezVarRecordsRenummer (id, varNum, startRec, endRec);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.14 CDFgetMaxWrittenRecNums

```
int CDFgetMaxWrittenRecNums ( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
TYPE rVarsMaxNum, /* out -- Maximum record number among all rVariables. */
```

```

TYPE zVarsMaxNum);          /* out -- Maximum record number among all zVariables. */
                             /* TYPE -- int* or "out int" */

```

CDFgetMaxWrittenRecNums returns the maximum written record number for the rVariables and zVariables in a CDF. The maximum record number for rVariables or zVariables is one less than the maximum number of records among all respective variables.

The arguments to CDFgetMaxWrittenRecNums are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
rVarsMaxNum	Maximum record number among all rVariables.
zVarsMaxNum	Maximum record number among all zVariables.

4.3.14.1. Example(s)

The following example returns the maximum written record numbers among all rVariables and zVariables of the CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  rVarsMaxNum;     /* Maximum record number among all rVariables. */
int  zVarsMaxNum;     /* Maximum record number among all zVariables. */
.
.
try {
    ....
    status = CDFgetMaxWrittenRecNums (id, &rVarsMaxNum, &zVarsMaxNum);
    Or,
    status = CDFgetMaxWrittenRecNums (id, out rVarsMaxNum, out zVarsMaxNum);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.15 CDFgetNumrVars

```

int CDFgetNumrVars (          /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
TYPE numVars);             /* out -- Total number of rVariables. */
                             /* TYPE -- int* or "out int" */

```

CDFgetNumrVars returns the total number of rVariables in a CDF.

The arguments to CDFgetNumrVars are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numVars	Number of rVariables.

4.3.15.1. Example(s)

The following example returns the total number of rVariables in a CDF.

```

.
.
int  status;           /* Returned status code. */
void* id;             /* CDF identifier. */
int  numVars;         /* Number of zVariables. */

.
.
try {
    ....
    status = CDFgetNumrVars (id, &numVars);
    Or,
    status = CDFgetNumrVars (id, out numVars);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.16 CDFgetNumzVars

```

int CDFgetNumzVars (           /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
TYPE numVars);             /* out -- Total number of zVariables. */
                             /* TYPE -- int* or "out int". */

```

CDFgetNumzVars returns the total number of zVariables in a CDF.

The arguments to CDFgetNumzVars are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numVars	Number of zVariables.

4.3.16.1. Example(s)

The following example returns the total number of zVariables in a CDF.

```
.
.
.
int  status;           /* Returned status code. */
void* id;             /* CDF identifier. */
int  numVars;        /* Number of zVariables. */

.
.
try {
    ....
    status = CDFgetNumzVars (id, &numVars);
    Or,
    status = CDFgetNumzVars (id, out numVars);

...
...
} catch (CDFException ex) {
    ...
}.

```

4.3.17 CDFgetrVarAllocRecords

```
int CDFgetrVarAllocRecords(           /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
TYPE numRecs);                       /* out -- Allocated number of records. */
                                       /* TYPE -- int* or "out int". */
```

CDFgetrVarAllocRecords returns the number of records allocated for the specified rVariable in a CDF. Refer to the CDF User's Guide for a description of allocating variable records in a single-file CDF.

The arguments to CDFgetrVarAllocRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numRecs	Number of allocated records.

4.3.17.1. Example(s)

The following example returns the number of allocated records for rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int  numRecs;        /* The allocated records. */
.
.
try {
    ....
    varNum = CDFgetrVarNum (id, "MY_VAR");
.
    status = CDFgetrVarAllocRecords (id, varNum, &numRecs);
Or,
    status = CDFgetrVarAllocRecords (id, varNum, out numRecs);
...
} catch (CDFException ex) {
    ...
}.

```

4.3.18 CDFgetrVarBlockingFactor

```

int CDFgetrVarBlockingFactor(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
TYPE bf);                             /* out -- Blocking factor. */
                                         /* TYPE -- int* or "out int". */

```

CDFgetrVarBlockingFactor returns the blocking factor for the specified rVariable in a CDF. Refer to the CDF User's Guide for a description of the blocking factor.

The arguments to CDFgetrVarBlockingFactor are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
bf	The blocking factor. A value of zero (0) indicates that the default blocking factor will be used.

4.3.18.1. Example(s)

The following example returns the blocking factor for the rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */

```

```

int  bf;                                /* The blocking factor. */
.
.
try {
....
    varNum = CDFgetVarNum (id, "MY_VAR");

    status = CDFgetrVarBlockingFactor (id, varNum, &bf);
..Or,
    status = CDFgetrVarBlockingFactor (id, varNum, out bf);
} catch (CDFException ex) {
....
}

```

4.3.19 CDFgetrVarCacheSize

```

int CDFgetrVarCacheSize(                /* out -- Completion status code. */
void* id,                               /* in -- CDF identifier. */
int varNum,                             /* in -- Variable number. */
TYPE numBuffers);                     /* out -- Number of cache buffers. */
                                        /* TYPE -- int* or "out int". */

```

CDFgetrVarCacheSize returns the number of cache buffers being for the specified rVariable in a CDF. This operation is not applicable to a single-file CDF. Refer to the CDF User's Guide for a description of caching scheme used by the CDF library.

The arguments to CDFgetrVarCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numBuffers	Number of cache buffers.

4.3.19.1. Example(s)

The following example returns the number of cache buffers for rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                          /* CDF identifier. */
int  varNum;                            /* rVariable number. */
int  numBuffers;                         /* The number of cache buffers. */
.
.
try {
....
    varNum = CDFgetVarNum (id, "MY_VAR");

```



```

int  cPct;                                /* The compression percentage. */
.
.
try {
....
varNum = CDFgetVarNum (id, "MY_VAR");
cParms = new int[1];
fixed (int* pcParms = cParms) {
    status = CDFgetVarCompression (id, varNum, &cType, pcParms, &cPct);
}
Or
status = CDFgetVarCompression (id, varNum, out cType, out cParms, out cPct);
...
} catch (CDFException ex) {
...
}.

```

4.3.21 CDFgetrVarData

```

int CDFgetrVarData(                       /* out -- Completion status code. */
void* id,                                 /* in -- CDF identifier. */
int varNum,                               /* in -- Variable number. */
int recNum,                              /* in -- Record number. */
int[] indices,                           /* in -- Dimension indices. */
TYPE value);                             /* out -- Data value. */
/* TYPE -- void*, "out string" or "out object". */

```

CDFgetrVarData returns a data value from the specified indices, the location of the element, in the given record of the specified rVariable in a CDF.

The arguments to CDFgetrVarData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recNum	Record number.
indices	Dimension indices within the record.
value	Data value.

4.3.21.1. Example(s)

The following example returns two data values, the first and the fifth element, in Record 0 from rVariable "MY_VAR", a 2-dimensional (2 by 3) CDF_DOUBLE type variable, in a row-major CDF.


```

.
.
void* id;           /* CDF identifier. */
int  varNum;       /* rVariable number. */
int  recNum;       /* The record number. */
int[] indices = new int[2]; /* The dimension indices. */
double value1, value2; /* The data values. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    status = CDFgetrVarData (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    object value2a;
    status = CDFgetrVarData (id, varNum, recNum, indices, out value2a);
    value2 = (double) value2a;
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.22 CDFgetrVarDataType

```

int CDFgetrVarDataType(           /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
int varNum,                     /* in -- Variable number. */
TYPE dataType);               /* out -- Data type. */
                                /* TYPE -- int* or "out int" */

```

CDFgetrVarDataType returns the data type of the specified rVariable in a CDF. Refer to Section 2.6 for a description of the CDF data types.

The arguments to CDFgetrVarDataType are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
dataType	Data type.

4.3.22.1. Example(s)

The following example returns the data type of rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int  dataType;        /* The data type. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, “MY_VAR”);
    status = CDFgetrVarDataType (id, varNum, &dataType);
    Or
    status = CDFgetrVarDataType (id, varNum, out dataType);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.23 CDFgetrVarDimVariances

```

int CDFgetrVarDimVariances(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                         /* in -- Variable number. */
TYPE dimVarys);                   /* out -- Dimension variances. */
                                     /* TYPE -- int* or “out int[]”. */

```

CDFgetrVarDimVariances returns the dimension variances of the specified rVariable in a CDF. For 0-dimensional rVariable, this operation is not applicable. The dimension variances are described in section 2.10.

The arguments to CDFgetrVarDimVariances are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
dimVarys	Dimension variances.

4.3.23.1. Example(s)

The following example returns the dimension variances of the 2-dimensional rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */

```

```

int[] dimVarys;                               /* The dimension variances. */
.
.
try {
    ....

    dimVarys = new int[2];
    fixed (int* pdimVarys = dimVarys) {
...   status = CDFgetrVarDimVariances (id, CDFgetrVarNum (id, "MY_VAR"), pdimVarys);
    }
    Or
    status = CDFgetrVarDimVariances (id, CDFgetrVarNum (id, "MY_VAR"), out dimVarys);

...
} catch (CDFException ex) {
    ...
}.

```

4.3.24 CDFgetrVarInfo

```

int CDFgetrVarInfo(                           /* out -- Completion status code. */
void* id,                                     /* in -- CDF identifier. */
int varNum,                                   /* in -- Variable number. */
TYPE dataType,                               /* out -- Data type. */
TYPE numElems,                               /* out -- Number of elements. */
TYPE numDims,                               /* out -- Number of dimensions. */
TYPE2 dimSizes);                            /* out -- Dimension sizes. */
/* TYPE -- int* or "out int". */
/* TYPE2 -- int* or "out int[]". */

```

CDFgetrVarInfo returns the basic information about the specified rVariable in a CDF.

The arguments to CDFgetrVarInfo are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
dataType	Data type of the variable.
numElems	Number of elements for the data type of the variable.
numDims	Number of dimensions.
dimSizes	Dimension sizes.

4.3.24.1. Example(s)

The following example returns the basic information of rVariable “MY_VAR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  dataType;        /* The data type. */
int  numElems;        /* The number of elements. */
int  numDims;         /* The number of dimensions. */
int[] dimSizes;       /* The dimension sizes. */
.
.
try {
    ....

    dimVarys = new int[CDF_MAX_DIMS];
    fixed (int* pdimVarys = dimVarys) {
...   status = CDFgetrVarInfo (id, CDFgetrVarNum (id, "MY_VAR"), &dataType, &numElems,
                                &numDims, pdimVarys);
    }
    Or
    status = CDFgetrVarInfo (id, CDFgetrVarNum (id, "MY_VAR"), out dataType, out numElems,
                            out numDims, out dimVarys);

...
} catch (CDFException ex) {
    ...
}.
}
```

4.3.25 CDFgetrVarMaxAllocRecNum

```
int CDFgetrVarMaxAllocRecNum(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
TYPE maxRec);                        /* out -- Maximum allocated record #. */
                                        /* TYPE -- int* or "out int". */
```

CDFgetrVarMaxAllocRecNum returns the number of records allocated for the specified rVariable in a CDF.

The arguments to CDFgetrVarMaxAllocRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
maxRec	Number of records allocated.

4.3.25.1. Example(s)

The following example returns the maximum allocated record number for the rVariable “MY_VAR” in a CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  maxRec;          /* The maximum record number. */  
. .  
try {  
    ....  
    status = CDFgetrVarMaxAllocRecNum (id, CDFgetrVarNum (id, “MY_VAR”), &maxRec);  
    Or  
    status = CDFgetrVarMaxAllocRecNum (id, CDFgetrVarNum (id, “MY_VAR”), out maxRec);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.
```

4.3.26 CDFgetrVarMaxWrittenRecNum

```
int CDFgetrVarMaxWrittenRecNum (          /* out -- Completion status code. */  
void* id,                                /* in -- CDF identifier. */  
int varNum,                              /* in -- Variable number. */  
TYPE maxRec);                          /* out -- Maximum written record number. */  
                                          /* TYPE -- int* or “out int”. */
```

CDFgetrVarMaxWrittenRecNum returns the maximum record number written for the specified rVariable in a CDF.

The arguments to CDFgetrVarMaxWrittenRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
maxRec	Maximum written record number.

4.3.26.1. Example(s)

The following example returns the maximum record number written for the rVariable “MY_VAR” in a CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */
```

```

int maxRec;                               /* The maximum record number. */
.
.
try {
    ....
    status = CDFgetrVarMaxWrittenRecNum (id, CDFgetVarNum (id, "MY_VAR"), &maxRec);
Or
    status = CDFgetrVarMaxWrittenRecNum (id, CDFgetVarNum (id, "MY_VAR"), out maxRec);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.27 CDFgetrVarName

```

int CDFgetrVarName(                        /* out -- Completion status code. */
void* id,                                  /* in -- CDF identifier. */
int varNum,                                /* in -- Variable number. */
out string varName);                       /* out -- Variable name. */

```

CDFgetrVarName returns the name of the specified rVariable, by its number, in a CDF.

The arguments to CDFgetrVarName are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
varName	The name of the variable.

4.3.27.1. Example(s)

The following example returns the name of the rVariable whose variable number is 1.

```

.
.
.
void* id;                                  /* CDF identifier. */
int varNum;                                /* rVariable number. */
string varName;                            /* The name of the variable. */
.
.
varNum = 1;
try {
    ....
    status = CDFgetrVarName (id, varNum, out varName);
    ...
    ...
}

```

```

} catch (CDFException ex) {
    ...
}.

```

4.3.28 CDFgetrVarNumElements

```

int CDFgetrVarNumElements(                               /* out -- Completion status code. */
void* id,                                                /* in -- CDF identifier. */
int varNum,                                             /* in -- Variable number. */
TYPE numElems);                                       /* out -- Number of elements. */
                                                         /* TYPE -- int* or "out int". */

```

CDFgetrVarNumElements returns the number of elements for each data value of the specified rVariable in a CDF. For character data type (CDF_CHAR and CDF_UCHAR), the number of elements is the number of characters in the string. For other data types, the number of elements will always be one (1).

The arguments to CDFgetrVarNumElements are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numElems	Number of elements.

4.3.28.1. Example(s)

The following example returns the number of elements for the data type from rVariable "MY_VAR" in a CDF.

```

.
.
.
void* id;                                               /* CDF identifier. */
int numElems;                                          /* The number of elements. */
.
.
try {
    ....
    status = CDFgetrVarNumElements (id, CDFgetrVarNum (id, "MY_VAR"), &numElems);
    Or
    status = CDFgetrVarNumElements (id, CDFgetrVarNum (id, "MY_VAR"), out numElems);...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.29 CDFgetrVarNumRecsWritten

```
int CDFgetrVarNumRecsWritten(                                     /* out -- Completion status code. */
void* id,                                                         /* in -- CDF identifier. */
int varNum,                                                       /* in -- Variable number. */
TYPE numRecs);                                                  /* out -- Number of written records. */
                                                                /* TYPE -- int* or "out int". */
```

CDFgetrVarNumRecsWritten returns the number of records written for the specified rVariable in a CDF. This number may not correspond to the maximum record written if the rVariable has sparse records.

The arguments to CDFgetrVarNumRecsWritten are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numRecs	Number of written records.

4.3.29.1. Example(s)

The following example returns the number of written records from rVariable "MY_VAR" in a CDF.

```
.
.
.
void*      id;           /* CDF identifier. */
int  numRecs;          /* The number of written records. */
.
.
try {
    ....
    status = CDFgetrVarNumRecsWritten (id, CDFgetrVarNum (id, "MY_VAR"), &numRecs);
    Or
    status = CDFgetrVarNumRecsWritten (id, CDFgetrVarNum (id, "MY_VAR"), out numRecs);
    ...
} catch (CDFException ex) {
    ...
}.
```

4.3.30 CDFgetrVarPadValue

```
int CDFgetrVarPadValue(                                         /* out -- Completion status code. */
void* id,                                                         /* in -- CDF identifier. */
int varNum,                                                       /* in -- Variable number. */
TYPE value);                                                  /* out -- Pad value. */
                                                                /* TYPE -- void*, "out string" or "out object". */
```


CDFgetrVarPadValue returns the pad value of the specified rVariable in a CDF. If a pad value has not been explicitly specified for the rVariable through CDFsetrVarPadValue, the informational status code **NO_PADVALUE_SPECIFIED** will be returned. Since a variable's pad value is an optional, no exception is thrown while trying to get its value if its value is not set. It's recommended to check the returned status after the method is called.

The arguments to CDFgetrVarPadValue are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
value	Pad value.

4.3.30.1. Example(s)

The following example returns the pad value from rVariable "MY_VAR", a CDF_INT4 type variable, in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  padValue;        /* The pad value. */
.
.
try {
    ....
    status = CDFgetrVarPadValue (id, CDFgetrVarNum (id, "MY_VAR"), &padValue);
    Or
    object padValueo;
    status = CDFgetrVarPadValue (id, CDFgetrVarNum (id, "MY_VAR"), out padValueo);
    if (status != NO_PADVALUE_SPECIFIED) {
        padValue = (int) padValueo;
    }
    .
    }
. ....
. ....
} catch (CDFException ex) {
    ...
}.

```

4.3.31 CDFgetrVarRecordData

```
int CDFgetrVarRecordData(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int recNum,                        /* in -- Record number. */

```



```

int varNum,                                /* in -- Variable number. */
TYPE recVary);                             /* out -- Record variance. */
                                           /* TYPE -- int* or "out int". */

```

CDFgetrVarRecVariance returns the record variance of the specified rVariable in a CDF. The record variances are described in Section 2.10.

The arguments to CDFgetrVarRecVariance are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recVary	Record variance.

4.3.32.1. Example(s)

The following example returns the record variance for the rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;                               /* CDF identifier. */
int  recVary;                               /* The record variance. */
.
.
try {
....
    status = CDFgetrVarRecVariance (id, CDFgetVarNum (id, "MY_VAR"), &recVary);
Or
    status = CDFgetrVarRecVariance (id, CDFgetVarNum (id, "MY_VAR"), out recVary);...
...
} catch (CDFException ex) {
...
}.

```

4.3.33 CDFgetrVarReservePercent

```

int CDFgetrVarReservePercent(               /* out -- Completion status code. */
void* id,                                  /* in -- CDF identifier. */
int varNum,                                /* in -- Variable number. */
TYPE percent);                             /* out -- Reserve percentage. */
                                           /* TYPE -- int* or "out int". */

```

CDFgetrVarReservePercent returns the compression reserve percentage being used for the specified rVariable in a CDF. This operation only applies to compressed rVariables. Refer to the CDF User’s Guide for a description of the reserve scheme used by the CDF library.

The arguments to CDFgetrVarReservePercent are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
percent	The reserve percentage.

4.3.33.1. Example(s)

The following example returns the compression reserve percentage from the compressed rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  percent;         /* The compression reserve percentage. */
.
.
try {
    ....
    status = CDFgetrVarReservePercent (id, CDFgetrVarNum (id, "MY_VAR"), &percent);
    Or
    status = CDFgetrVarReservePercent (id, CDFgetrVarNum (id, "MY_VAR"), out percent);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.34 CDFgetrVarsDimSizes

```

int CDFgetrVarsDimSizes(          /* out -- Completion status code. */
void* id,                        /* in -- CDF identifier. */
TYPE dimSizes);                /* out -- Dimension sizes. */
                                /* TYPE -- int* or "out int[]". */

```

CDFgetrVarsDimSizes returns the size of each dimension for the rVariables in a CDF. (all rVariables have the same dimensional sizes.) For 0-dimensional rVariables, this operation is not applicable.

The arguments to CDFgetrVarsDimSizes are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
dimSizes	Dimension sizes. Each element of dimSizes receives the corresponding dimension size.

4.3.34.1. Example(s)

The following example returns the dimension sizes for rVariables in a CDF.

```
.  
.br/>.br/>void*      id;                /* CDF identifier. */  
.int[]     dimSizes;         /* Dimensional sizes. */  
  
.try {  
    ....  
    dimSizes = new int[CDF_MAX_DIMS];  
    fixed (int* pdimSizes = dimSizes) {  
        status = CDFgetrVarsDimSizes (id, pdimSizes);  
    }  
    Or  
    status = CDFgetrVarsDimSizes (id, out dimSizes);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.3.35 CDFgetrVarSeqData

```
int CDFgetrVarSeqData(                /* out -- Completion status code. */  
void* id,                             /* in -- CDF identifier. */  
int varNum,                           /* in -- Variable number. */  
TYPE value);                          /* out -- Data value. */  
/* TYPE -- void*, "out string" or "out object". */
```

CDFgetrVarSeqData reads one value from the specified rVariable in a CDF at the current sequential value (position). After the read, the current sequential value is automatically incremented to the next value. An error is returned if the current sequential value is past the last record of the rVariable. Use CDFsetrVarSeqPos method to set the current sequential value (position).

The arguments to CDFgetrVarSeqData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number from which to read data.
value	The buffer to store the value.

4.3.35.1. Example(s)

The following example will read the first two data values from the beginning of record number 2 (from a 2-dimensional rVariable whose data type is CDF_INT4) in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* The variable number from which to read data */
int  value1, value2;  /* The data value. */
int[] indices = new int[2]; /* The indices in a record. */
int  recNum;          /* The record number. */
.
.
recNum = 2;
indices[0] = 0;
indices[1] = 0;
try {
    ....
    status = CDFsetrVarSeqPos (id, varNum, recNum, indices);
    status = CDFgetrVarSeqData (id, varNum, &value1);
    object value2o;
    status = CDFgetrVarSeqData (id, varNum, out value2o);
    value2 = (int) value2o;
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.36 CDFgetrVarSeqPos

```

int CDFgetrVarSeqPos(          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int varNum,                  /* in -- Variable number. */
TYPE recNum,                /* out -- Record number. */
TYPE2 indices);            /* out -- Indices in a record. */
                                /* TYPE -- int* or "out int". */
                                /* TYPE2 -- int* or "out int[]". */

```

CDFgetrVarSeqPos returns the current sequential value (position) for sequential access for the specified rVariable in a CDF. Note that a current sequential value is maintained for each rVariable individually. Use CDFsetrVarSeqPos method to set the current sequential value.

The arguments to CDFgetrVarSeqPos are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recNum	rVariable record number.
indices	Dimension indices. Each element of indices receives the corresponding dimension index. For 0-dimensional rVariable, this argument is ignored, but must be presented.

4.3.36.1. Example(s)

The following example returns the location for the current sequential value (position), the record number and indices within it, from a 2-dimensional rVariable named MY_VAR in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  recNum;          /* number. */
int[] indices;        /* The indices. */
.
.
try {
    ...
    indices = new int[2];
    fixed (int* pindices = indices) {
        status = CDFgetrVarSeqPos (id, CDFgetrVarNum(id, "MY_VAR"), &recNum, pindices);
    }
    Or
    status = CDFgetrVarSeqPos (id, CDFgetrVarNum(id, "MY_VAR"), out recNum, out indices);
    ...
} catch (CDFException ex) {
    ...
}.
```

4.3.37 CDFgetrVarsMaxWrittenRecNum

```
int CDFgetrVarsMaxWrittenRecNum(          /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
TYPE recNum);                          /* out -- Maximum record number. */
                                          /* TYPE -- int* or "out int". */
```

CDFgetrVarsMaxWrittenRecNum returns the maximum record number among all of the rVariables in a CDF. Note that this is not the number of written records but rather the maximum written record number (that is one less than the number of records). A value of negative one (-1) indicates that rVariables contain no records. The maximum record number for an individual rVariable may be acquired using the CDFgetrVarMaxWrittenRecNum method call.

Suppose there are three rVariables in a CDF: Var1, Var2, and Var3. If Var1 contains 15 records, Var2 contains 10 records, and Var3 contains 95 records, then the value returned from CDFgetrVarsMaxWrittenRecNum would be 95.

The arguments to CDFgetrVarsMaxWrittenRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
recNum	Maximum written record number.

4.3.37.1. Example(s)

The following example returns the maximum record number for all of the rVariables in a CDF.

```
.
.
void*      id;          /* CDF identifier. */
int  recNum;          /* The maximum record number. */
.
.
try {
....
    status = CDFgetrVarsMaxWrittenRecNum (id, &recNum);
    Or
    status = CDFgetrVarsMaxWrittenRecNum (id, out recNum);
...
...
} catch (CDFException ex) {
....
}.
.
```

4.3.38 CDFgetrVarsNumDims

```
int CDFgetrVarsNumDims(          /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
TYPE numDims);                 /* out -- Number of dimensions. */
                                /* TYPE -- int* or "out int". */
```

CDFgetrVarsNumDims returns the number of dimensions (dimensionality) for the rVariables in a CDF.

The arguments to CDFgetrVarsNumDims are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numDims	Number of dimensions.

4.3.38.1. Example(s)

The following example returns the number of dimensions for rVariables in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  numDims;          /* The dimensionality of the variable. */
.
.
try {
```



```

....
status = CDFgetrVarsNumDims (id, &numDims);
Or
status = CDFgetrVarsNumDims (id, out numDims);
...
...
} catch (CDFException ex) {
...
}.

```

4.3.39 CDFgetrVarSparseRecords

```

int CDFgetrVarSparseRecords(                                     /* out -- Completion status code. */
void* id,                                                       /* in -- CDF identifier. */
int varNum,                                                     /* in -- The variable number. */
TYPE sRecordsType);                                           /* out -- The sparse records type. */
                                                                /* TYPE -- int* or "out int". */

```

CDFgetrVarSparseRecords returns the sparse records type of the rVariable in a CDF. Refer to Section 2.12.1 for the description of sparse records.

The arguments to CDFgetrVarSparseRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	Variable number.
sRecordsType	The sparse records type.

4.3.39.1. Example(s)

The following example returns the sparse records type of the rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                                                 /* CDF identifier. */
int  sRecordsType;                                           /* The sparse records type. */
.
.
try {
....
status = CDFgetrVarSparseRecords (id, CDFgetVarNum(id, "MY_VAR"), &sRecordsType);
Or
status = CDFgetrVarSparseRecords (id, CDFgetVarNum(id, "MY_VAR"), out sRecordsType);...
...
} catch (CDFException ex) {
...

```

```
    }.
```

4.3.40 CDFgetVarNum¹⁰

```
int CDFgetVarNum(           /* out -- Variable number. */  
void* id,                 /* in -- CDF identifier. */  
string varName);         /* in -- Variable name. */
```

CDFgetVarNum returns the variable number for the given variable name (rVariable or zVariable). If the variable is found, CDFgetVarNum returns its variable number - which will be equal to or greater than zero (0). If an error occurs (e.g., the variable does not exist in the CDF), an error code (of type int) is returned, and an exception is thrown. Error codes are less than zero (0). The returned variable number should be used in the functions of the same variable type, rVariable or zVariable. If it is an rVariable, functions dealing with rVariables should be used. Similarly, functions for zVariables should be used for zVariables.

The arguments to CDFgetVarNum are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varName	The name of the variable to search. This may be at most CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.

CDFgetVarNum may be used as an embedded function call where an rVariable or zVariable number is needed.

4.3.40.1. Example(s)

In the following example CDFgetVarNum is used as an embedded function call when inquiring about a zVariable.

```
.  
. .  
. .  
void*      id;           /* CDF identifier. */  
int  status;           /* Returned status code. */  
string  varName;       /* Variable name. */  
int  dataType;        /* Data type of the zVariable. */  
int  numElements;     /* Number of elements (of the data type). */  
int  numDims;         /* Number of dimensions. */  
int[] dimSizes;       /* Dimension sizes. */  
int  recVariance;     /* Record variance. */  
int[] dimVariances;   /* Dimension variances. */  
. .  
. .  
try {  
    ....  
    dimSizes = new int[1];  
    dimVariances = new int[1];
```

¹⁰ Since no two variables, either rVariable or zVariable, can have the same name, this function now returns the variable number for the given rVariable or zVariable name (if the variable name exists in a CDF).


```

.
.
try {
....
    varNum = CDFgetVarNum (id, "MY_VAR");
.
    status = CDFgetVarAllocRecords (id, varNum, &numRecs);
Or,
    status = CDFgetVarAllocRecords (id, varNum, out numRecs);
...
...
} catch (CDFException ex) {
....
}.

```

4.3.42 CDFgetVarBlockingFactor

```

int CDFgetVarBlockingFactor(                                     /* out -- Completion status code. */
void* id,                                                       /* in -- CDF identifier. */
int varNum,                                                     /* in -- Variable number. */
TYPE bf);                                                      /* out -- Blocking factor. */
                                                                /* TYPE -- int* or "out int". */

```

CDFgetVarBlockingFactor returns the blocking factor for the specified zVariable in a CDF. Refer to the CDF User's Guide for a description of the blocking factor.

The arguments to CDFgetVarBlockingFactor are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
bf	The blocking factor. A value of zero (0) indicates that the default blocking factor will be used.

4.3.42.1. Example(s)

The following example returns the blocking factor for the zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                                                 /* CDF identifier. */
int  varNum;                                                  /* zVariable number. */
int  bf;                                                      /* The blocking factor. */
.
.
try {
....
    varNum = CDFgetVarNum (id, "MY_VAR");

```

```

    status = CDFgetzVarBlockingFactor (id, varNum, &bf);
..Or,
    status = CDFgetzVarBlockingFactor (id, varNum, out bf);
} catch (CDFException ex) {
    ...
}.

```

4.3.43 CDFgetzVarCacheSize

```

int CDFgetzVarCacheSize(                                     /* out -- Completion status code. */
void* id,                                                   /* in -- CDF identifier. */
int varNum,                                                /* in -- Variable number. */
TYPE numBuffers);                                         /* out -- Number of cache buffers. */
                                                         /* TYPE -- int* or "out int". */

```

CDFgetzVarCacheSize returns the number of cache buffers being for the specified zVariable in a CDF. This operation is not applicable to a single-file CDF. Refer to the CDF User’s Guide for a description of caching scheme used by the CDF library.

The arguments to CDFgetzVarCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
numBuffers	Number of cache buffers.

4.3.43.1. Example(s)

The following example returns the number of cache buffers for zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;                                           /* CDF identifier. */
int  varNum;                                           /* zVariable number. */
int  numBuffers;                                       /* The number of cache buffers. */
.
.
try {
    ....
    varNum = CDFgetzVarNum (id, "MY_VAR");
.
    status = CDFgetzVarCacheSize (id, varNum, &numBuffers);
Or,
    status = CDFgetzVarCacheSize (id, varNum, out numBuffers);
.
.
.
.

```

```

} catch (CDFException ex) {
    ...
}.

```

4.3.44 CDFgetzVarCompression

```

int CDFgetzVarCompression(                                     /* out -- Completion status code. */
void* id,                                                     /* in -- CDF identifier. */
int varNum,                                                  /* in -- Variable number. */
TYPE cType,                                                 /* out -- Compression type. */
TYPE2 cParms,                                              /* out -- Compression parameters. */
TYPE cPct);                                                /* out -- Compression percentage. */
                                                             /* TYPE -- int* or "out int". */
                                                             /* TYPE2 -- int* or "out int[]". */

```

CDFgetzVarCompression returns the compression type/parameters and compression percentage of the specified zVariable in a CDF. Refer to Section 2.11 for a description of the CDF supported compression types/parameters. The compression percentage is the result of the compressed size from all variable records divided by its original, uncompressed variable size.

The arguments to CDFgetzVarCompression are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
cType	The compression type.
cParms	The compression parameters.
cPct	The percentage of the uncompressed size of zVariable's data values needed to store the compressed values.

4.3.44.1. Example(s)

The following example returns the compression information for zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                                               /* CDF identifier. */
int  varNum;                                               /* zVariable number. */
int  cType;                                               /* The compression type. */
int[] cParms;                                             /* The compression parameters. */
int  cPct;                                               /* The compression percentage. */
.
.
try {
    ....

```



```

int[] indices = new int[2];           /* The dimension indices. */
double value1, value2;               /* The data values. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    status = CDFgetVarData (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    object value2a;
    status = CDFgetVarData (id, varNum, recNum, indices, out value2a);
    value2 = (double) value2a;
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.46 CDFgetVarDataType

```

int CDFgetVarDataType(                /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                            /* in -- Variable number. */
TYPE dataType);                       /* out -- Data type. */
/* TYPE -- int* or "out int" */

```

CDFgetVarDataType returns the data type of the specified zVariable in a CDF. Refer to Section 2.6 for a description of the CDF data types.

The arguments to CDFgetVarDataType are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
dataType	Data type.

4.3.46.1. Example(s)

The following example returns the data type of zVariable "MY_VAR" in a CDF.

```

.
.
.

```



```

void*      id;          /* CDF identifier. */
int  varNum;          /* zVariable number. */
int  dataType;        /* The data type. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    status = CDFgetzVarDataType (id, varNum, &dataType);
    Or
    status = CDFgetzVarDataType (id, varNum, out dataType);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.47 CDFgetzVarDimSizes

```

int CDFgetzVarDimSizes(          /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
int varNum,                     /* in -- Variable number. */
TYPE dimSizes);               /* out -- Dimension sizes. */
                                /* TYPE -- int* or "out int[]". */

```

CDFgetzVarDimSizes returns the size of each dimension for the specified zVariable in a CDF. For 0-dimensional zVariables, this operation is not applicable.

The arguments to CDFgetzVarDimSizes are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number
dimSizes	Dimension sizes. Each element of dimSizes receives the corresponding dimension size.

4.3.47.1. Example(s)

The following example returns the dimension sizes for zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
.int[]     dimSizes;    /* Dimensional sizes. */

.try {
    ....
    dimSizes = new int[CDF_MAX_DIMS];

```

```

    fixed (int* pdimSizes = dimSizes) {
        status = CDFgetzVarDimSizes (id, CDFgetVarNum(id, "MY_VAR"), pdimSizes);
    }
    Or
    status = CDFgetzVarDimSizes (id, CDFgetVarNum(id, "MY_VAR"), out dimSizes);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.48 CDFgetzVarDimVariances

```

int CDFgetzVarDimVariances(                                     /* out -- Completion status code. */
void* id,                                                       /* in -- CDF identifier. */
int varNum,                                                    /* in -- Variable number. */
TYPE dimVarys);                                              /* out -- Dimension variances. */
                                                             /* TYPE -- int* or "out int[]". */

```

CDFgetzVarDimVariances returns the dimension variances of the specified zVariable in a CDF. For 0-dimensional zVariable, this operation is not applicable. The dimension variances are described in section 2.10.

The arguments to CDFgetzVarDimVariances are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
dimVarys	Dimension variances.

4.3.48.1. Example(s)

The following example returns the dimension variances of the 2-dimensional zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                                               /* CDF identifier. */
int[] dimVarys;                                             /* The dimension variances. */
.
.
try {
    ....

    dimVarys = new int[2];
    fixed (int* pdimVarys = dimVarys) {
...   status = CDFgetzVarDimVariances (id, CDFgetVarNum (id, "MY_VAR"), pdimVarys);
    }
    Or

```



```

.
try {
    ....

    dimVarys = new int[CDF_MAX_DIMS];
    fixed (int* pdimVarys = dimVarys) {
...   status = CDFgetzVarInfo (id, CDFgetVarNum (id, "MY_VAR"), &dataType, &numElems,
                                   &numDims, pdimVarys);
    }
    Or
    status = CDFgetzVarInfo (id, CDFgetVarNum (id, "MY_VAR"), out dataType, out numElems,
                            out numDims, out dimVarys);

...
} catch (CDFException ex) {
    ...
}.

```

4.3.50 CDFgetzVarMaxAllocRecNum

```

int CDFgetzVarMaxAllocRecNum(                                     /* out -- Completion status code. */
void* id,                                                         /* in -- CDF identifier. */
int varNum,                                                       /* in -- Variable number. */
TYPE maxRec);                                                  /* out -- Maximum allocated record #. */
                                                                /* TYPE -- int* or "out int". */

```

CDFgetzVarMaxAllocRecNum returns the number of records allocated for the specified zVariable in a CDF.

The arguments to CDFgetzVarMaxAllocRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
maxRec	Number of records allocated.

4.3.50.1. Example(s)

The following example returns the maximum allocated record number for the zVariable "MY_VAR" in a CDF.

```

.
.
.
void* id;                                                         /* CDF identifier. */
int maxRec;                                                       /* The maximum record number. */
.
.
try {

```

```

....
status = CDFgetzVarMaxAllocRecNum (id, CDFgetzVarNum (id, "MY_VAR"), &maxRec);
Or
status = CDFgetzVarMaxAllocRecNum (id, CDFgetzVarNum (id, "MY_VAR"), out maxRec);
...
...
} catch (CDFException ex) {
...
}.

```

4.3.51 CDFgetzVarMaxWrittenRecNum

```

int CDFgetzVarMaxWrittenRecNum (          /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
int varNum,                              /* in -- Variable number. */
TYPE maxRec);                          /* out -- Maximum written record number. */
                                          /* TYPE -- int* or "out int". */

```

CDFgetzVarMaxWrittenRecNum returns the maximum record number written for the specified zVariable in a CDF.

The arguments to CDFgetzVarMaxWrittenRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
maxRec	Maximum written record number.

4.3.51.1. Example(s)

The following example returns the maximum record number written for the zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  maxRec;          /* The maximum record number. */
.
.
try {
....
status = CDFgetzVarMaxWrittenRecNum (id, CDFgetzVarNum (id, "MY_VAR"), &maxRec);
Or
status = CDFgetzVarMaxWrittenRecNum (id, CDFgetzVarNum (id, "MY_VAR"), out maxRec);
...
...
} catch (CDFException ex) {
...
}.

```



```

TYPE numDims);                               /* out -- Number of dimensions. */
                                              /* TYPE -- int* or "out int". */

```

CDFgetzVarNumDims returns the number of dimensions (dimensionality) for the specified zVariable in a CDF.

The arguments to CDFgetzVarNumDims are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number
numDims	Number of dimensions.

4.3.53.1. Example(s)

The following example returns the number of dimensions for zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;                               /* CDF identifier. */
int  numDims;                               /* The dimensionality of the variable. */
.
.
try {
    ....
    status = CDFgetzVarNumDims (id, CDFgetzVarNum(id, "MY_VAR"), &numDims);
    Or
    status = CDFgetzVarNumDims (id, CDFgetzVarNum(id, "MY_VAR"), out numDims);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.54 CDFgetzVarNumElements

```

int CDFgetzVarNumElements(                   /* out -- Completion status code. */
void* id,                                   /* in -- CDF identifier. */
int varNum,                                 /* in -- Variable number. */
TYPE numElems);                           /* out -- Number of elements. */
                                              /* TYPE -- int* or "out int". */

```

CDFgetzVarNumElements returns the number of elements for each data value of the specified zVariable in a CDF. For character data type (CDF_CHAR and CDF_UCHAR), the number of elements is the number of characters in the string. For other data types, the number of elements will always be one (1).

The arguments to CDFgetzVarNumElements are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
numElems	Number of elements.

4.3.54.1. Example(s)

The following example returns the number of elements for the data type from zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  numElems;        /* The number of elements. */
.
.
try {
    ....
    status = CDFgetzVarNumElements (id, CDFgetVarNum (id, “MY_VAR”), &numElems);
    Or
    status = CDFgetzVarNumElements (id, CDFgetVarNum (id, “MY_VAR”), out numElems);...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.55 CDFgetzVarNumRecsWritten

```

int CDFgetzVarNumRecsWritten(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
TYPE numRecs);                       /* out -- Number of written records. */
                                         /* TYPE -- int* or “out int”. */

```

CDFgetzVarNumRecsWritten returns the number of records written for the specified zVariable in a CDF. This number may not correspond to the maximum record written if the zVariable has sparse records.

The arguments to CDFgetzVarNumRecsWritten are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
numRecs	Number of written records.

4.3.55.1. Example(s)

The following example returns the number of written records from zVariable “MY_VAR” in a CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  numRecs;          /* The number of written records. */  
. .  
try {  
    ....  
    status = CDFgetzVarNumRecsWritten (id, CDFgetVarNum (id, “MY_VAR”), &numRecs);  
    Or  
    status = CDFgetzVarNumRecsWritten (id, CDFgetVarNum (id, “MY_VAR”), out numRecs);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.3.56 CDFgetzVarPadValue

```
int CDFgetzVarPadValue(          /* out -- Completion status code. */  
void* id,                      /* in -- CDF identifier. */  
int varNum,                    /* in -- Variable number. */  
TYPE value);                  /* out -- Pad value. */  
                               /* TYPE -- void*, “out string” or “out object”. */
```

CDFgetzVarPadValue returns the pad value of the specified zVariable in a CDF. If a pad value has not been explicitly specified for the zVariable through CDFsetzVarPadValue, the informational status code **NO_PADVALUE_SPECIFIED** will be returned. Since a variable’s pad value is an optional, no exception is thrown while trying to get its value if its value is not set. It’s recommended to check the returned status after the method is called.

The arguments to CDFgetzVarPadValue are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
value	Pad value.

4.3.56.1. Example(s)

The following example returns the pad value from zVariable “MY_VAR”, a CDF_INT4 type variable, in a CDF.

```
.
```

```

.
.
void*      id;          /* CDF identifier. */
int  padValue;        /* The pad value. */
.
.
try {
    ....
    status = CDFgetzVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), &padValue);
Or
    Object padValueo;
    status = CDFgetzVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), out padValueo);
    if (status != NO_PADVALUE_SPECIFIED) {
        padValue = (int) padValueo;
    }
}
.
}
....
...
} catch (CDFException ex) {
    ...
}.

```

4.3.57 CDFgetzVarRecordData

```

int CDFgetzVarRecordData(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int recNum,                         /* in -- Record number. */
TYPE buffer);                    /* out -- Record data. */
/* TYPE -- void*, "out string", "out string[]" or "out object". */

```

CDFgetzVarRecordData returns an entire record at a given record number for the specified zVariable in a CDF. The buffer should be large enough to hold the entire data values form the variable.

The arguments to CDFgetzVarRecordData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recNum	Record number.
buffer	The buffer holding the entire record data.

4.3.57.1. Example(s)

The following example will read two full records (record numbers 2 and 5) from zVariable “MY_VAR”, a 2-dimension (2 by 3), CDF_INT4 type variable, in a CDF. The variable’s dimension variances are all VARY.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* zVariable number. */
int[,] buffer1;       /* The data holding buffer – pre-allocation. */
int[,] buffer2;       /* The data holding buffer – API allocation. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, “MY_VAR”);
    buffer1 = new int[2,3];
    fixed (void* pBuffer1 = buffer1) {
        status = CDFgetzVarRecordData (id, varNum, 2, pBuffer1);
    }
    status = CDFgetzVarRecordData (id, varNum, 5, out buffer2);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.58 CDFgetzVarRecVariance

```

int CDFgetzVarRecVariance(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
TYPE recVary);                   /* out -- Record variance. */
                                  /* TYPE -- int* or “out int”. */

```

CDFgetzVarRecVariance returns the record variance of the specified zVariable in a CDF. The record variances are described in Section 2.10.

The arguments to CDFgetzVarRecVariance are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recVary	Record variance.

4.3.58.1. Example(s)

The following example returns the record variance for the zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  recVary;         /* The record variance. */
.
.
try {
....
    status = CDFgetzVarRecVariance (id, CDFgetzVarNum (id, "MY_VAR"), &recVary);
Or
    status = CDFgetzVarRecVariance (id, CDFgetzVarNum (id, "MY_VAR"), out recVary);...
...
} catch (CDFException ex) {
....
}.

```

4.3.59 CDFgetzVarReservePercent

```

int CDFgetzVarReservePercent(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
TYPE percent);                       /* out -- Reserve percentage. */
                                         /* TYPE -- int* or "out int". */

```

CDFgetzVarReservePercent returns the compression reserve percentage being used for the specified zVariable in a CDF. This operation only applies to compressed zVariables. Refer to the CDF User's Guide for a description of the reserve scheme used by the CDF library.

The arguments to CDFgetzVarReservePercent are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
percent	The reserve percentage.

4.3.59.1. Example(s)

The following example returns the compression reserve percentage from the compressed zVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  percent;         /* The compression reserve percentage. */
.

```

```

.
try {
....
    status = CDFgetzVarReservePercent (id, CDFgetVarNum (id, "MY_VAR"), &percent);
Or
    status = CDFgetzVarReservePercent (id, CDFgetVarNum (id, "MY_VAR"), out percent);
...
...
} catch (CDFException ex) {
...
}.

```

4.3.60 CDFgetzVarSeqData

```

int CDFgetzVarSeqData(                               /* out -- Completion status code. */
void* id,                                           /* in -- CDF identifier. */
int varNum,                                         /* in -- Variable number. */
TYPE value);                                       /* out -- Data value. */
                                                    /* TYPE -- void*, "out string" or "out object". */

```

CDFgetzVarSeqData reads one value from the specified zVariable in a CDF at the current sequential value (position). After the read, the current sequential value is automatically incremented to the next value. An error is returned if the current sequential value is past the last record of the zVariable. Use CDFsetzVarSeqPos method to set the current sequential value's position.

The arguments to CDFgetzVarSeqData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number from which to read data.
value	The buffer to store the value.

4.3.60.1. Example(s)

The following example will read the first two data values from the beginning of record number 2 (from a 2-dimensional zVariable whose data type is CDF_INT4) in a CDF.

```

.
.
.
void*      id;                                       /* CDF identifier. */
int  varNum;                                       /* The variable number from which to read data */
int  value1, value2;                                /* The data value. */
int[] indices = new int[2];                          /* The indices in a record. */
int  recNum;                                       /* The record number. */
.
.
recNum = 2;
indices[0] = 0;

```



```

.
.
try {
....
    indices = new int[2];
    fixed (int* pindices = indices) {
        status = CDFgetzVarSeqPos (id, CDFgetVarNum(id, "MY_VAR"), &recNum, pindices);
    }
    Or
    status = CDFgetzVarSeqPos (id, CDFgetVarNum(id, "MY_VAR"), out recNum, out indices);
...
} catch (CDFException ex) {
    ...
}
}

```

4.3.62 CDFgetzVarsMaxWrittenRecNum

```

int CDFgetzVarsMaxWrittenRecNum(                                     /* out -- Completion status code. */
void* id,                                                         /* in -- CDF identifier. */
TYPE recNum);                                                    /* out -- Maximum record number. */
                                                                /* TYPE -- int* or "out int". */

```

CDFgetzVarsMaxWrittenRecNum returns the maximum record number among all of the zVariables in a CDF. Note that this is not the number of written records but rather the maximum written record number (that is one less than the number of records). A value of negative one (-1) indicates that zVariables contain no records. The maximum record number for an individual zVariable may be acquired using the CDFgetVarMaxWrittenRecNum method call.

Suppose there are three zVariables in a CDF: Var1, Var2, and Var3. If Var1 contains 15 records, Var2 contains 10 records, and Var3 contains 95 records, then the value returned from CDFgetzVarsMaxWrittenRecNum would be 95.

The arguments to CDFgetzVarsMaxWrittenRecNum are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
recNum	Maximum written record number.

4.3.62.1. Example(s)

The following example returns the maximum record number for all of the zVariables in a CDF.

```

.
.
void* id;                                                         /* CDF identifier. */
int recNum;                                                       /* The maximum record number. */
.
.
try {
....
    status = CDFgetzVarsMaxWrittenRecNum (id, &recNum);

```

```

Or
    status = CDFgetzVarsMaxWrittenRecNum (id, out recNum);
...
...
} catch (CDFException ex) {
    ...
}.

```

4.3.63 CDFgetzVarSparseRecords

```

int CDFgetzVarSparseRecords(                                     /* out -- Completion status code. */
void* id,                                                       /* in -- CDF identifier. */
int varNum,                                                    /* in -- The variable number. */
TYPE sRecordsType);                                           /* out -- The sparse records type. */
                                                             /* TYPE -- int* or "out int". */

```

CDFgetzVarSparseRecords returns the sparse records type of the zVariable in a CDF. Refer to Section 2.12.1 for the description of sparse records.

The arguments to CDFgetzVarSparseRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	Variable number.
sRecordsType	The sparse records type.

4.3.63.1. Example(s)

The following example returns the sparse records type of the zVariable “MY_VAR” in a CDF.

```

.
.
.
void* id;                                                       /* CDF identifier. */
int sRecordsType;                                             /* The sparse records type. */
.
.
try {
    ....
    status = CDFgetzVarSparseRecords (id, CDFgetVarNum(id, "MY_VAR"), &sRecordsType);
Or
    status = CDFgetzVarSparseRecords (id, CDFgetVarNum(id, "MY_VAR"), out sRecordsType);...
    ...
} catch (CDFException ex) {
    ...
}.

```


4.3.64 CDFHyperGetrVarData

```
int CDFHyperGetrVarData(                                /* out -- Completion status code. */
void* id,                                              /* in -- CDF identifier. */
int varNum,                                           /* in -- rVariable number. */
int recStart,                                         /* in -- Starting record number. */
int recCount,                                         /* in -- Number of records. */
int recInterval,                                     /* in -- Reading interval between records. */
int[] indices,                                       /* in -- Dimension indices of starting value. */
int[] counts,                                        /* in -- Number of values along each dimension. */
int[] intervals,                                     /* in -- Reading intervals along each dimension. */
TYPE buffer);                                       /* out -- Buffer of values. */
/* TYPE -- void*, "out string", "out string[]" or "out object" */
```

CDFHyperGetrVarData is used to read one or more values for the specified rVariable. It is important to know the variable majority of the CDF before using this method because the values placed into the data buffer will be in that majority. CDFInquireCDF can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities.

The record number starts at 0, not 1. For example, if you want to read the first 5 records, the starting record number (recStart), the number of records to read (recCount), and the record interval (recInterval) should be 0, 5, and 1, respectively. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

The arguments to CDFHyperGetrVarData are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number from which to read data. This number may be determined with a call to CDFgetVarNum.
recStart	Record number at which to start reading.
recCount	Number of records to read.
recInterval	Reading interval between records (e.g., an interval of 2 means read every other record).
indices	Dimension indices (within each record) at which to start reading. Each element of indices specifies the corresponding dimension index. For 0-dimensional rVariable, this argument is ignored (but must be present).
counts	Number of values along each dimension to read. Each element of counts specifies the corresponding dimension count. For 0-dimensional rVariable, this argument is ignored (but must be present).
intervals	For each dimension, the dimension interval between reading (e.g., an interval of 2 means read every other value). Each element of intervals specifies the corresponding dimension interval. For 0-dimensional rVariable, this argument is ignored (but must be present).
buffer	The data holding buffer for the read values. The majority of the values in this buffer will be the same as that of the CDF. This buffer must be large to hold the values. CDFInquirerVar can be


```

int recCount,                /* in -- Number of records. */
int recInterval,           /* in -- Reading interval between records. */
int[] indices,             /* in -- Dimension indices of starting value. */
int[] counts,              /* in -- Number of values along each dimension. */
int[] intervals,          /* in -- Reading intervals along each dimension. */
TYPE buffer);            /* out -- Buffer of values. */
                          /* TYPE -- void*, "out string", "out string[]" or "out object".*/

```

CDFHyperGetzVarData is used to read one or more values for the specified zVariable. It is important to know the variable majority of the CDF before using this method because the values placed into the data buffer will be in that majority. CDFInquireCDF can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities.

The record number starts at 0, not 1. For example, if you want to read the first 5 records, the starting record number (recStart), the number of records to read (recCount), and the record interval (recInterval) should be 0, 5, and 1, respectively. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

The arguments to CDFHyperGetzVarData are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number from which to read data. This number may be determined with a call to CDFgetVarNum.
recStart	Record number at which to start reading.
recCount	Number of records to read.
recInterval	Reading interval between records (e.g., an interval of 2 means read every other record).
indices	Dimension indices (within each record) at which to start reading. Each element of indices specifies the corresponding dimension index. For 0-dimensional zVariable, this argument is ignored (but must be present).
counts	Number of values along each dimension to read. Each element of counts specifies the corresponding dimension count. For 0-dimensional zVariable, this argument is ignored (but must be present).
intervals	For each dimension, the dimension interval between reading (e.g., an interval of 2 means read every other value). Each element of intervals specifies the corresponding dimension interval. For 0-dimensional zVariable, this argument is ignored (but must be present).
buffer	The data holding buffer for the read values. The majority of the values in this buffer will be the same as that of the CDF. This buffer must be large to hold the values. CDFInquirezVar can be used to determine the zVariable's data type and number of elements (of that data type) at each value. If a dimensional array of strings is expected, then use object type.

4.3.65.1. Example(s)

The following example will read 3 records of data, starting at record number 13 (14th record), from a zVariable named Temperature. The variable is a 3-dimensional array with sizes [180,91,10] and the CDF's variable majority is ROW_MAJOR. The record variance is VARY, the dimension variances are [VARY,VARY,VARY], and the data type

is CDF_REAL4. This example is similar to the CDFgetzVarData example except that it uses a single call to CDFhyperGetzVarData (rather than numerous calls to CDFgetzVarData).

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
float[,,,] tmp;       /* Temperature values. */
int  varN;           /* zVariable number. */
int  recStart = 13;   /* Start record number. */
int  recCount = 3;    /* Number of records to read */
int  recInterval = 1; /* Record interval – read every record */
int[] indices = new int[] {0,0,0}; /* Dimension indices. */
int[] counts = new int[] {180,91,10}; /* Dimension counts. */
int[] intervals = new int[] {1,1,1}; /* Dimension intervals – read every value*/
.
.
try {
    varN = CDFgetVarNum (id, "Temperature");
    tmp = new float[3,180,91,10];
    fixed (void* ptmp = tmp) {
        status = CDFhyperGetzVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals,
                                      ptmp);
    }
}
Or
    status = CDFhyperGetzVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals,
                                  out tmp);
...
...
} catch (CDFException ex) {
    ...
}.

```

Note that if the CDF's variable majority had been COLUMN_MAJOR, the tmp array would have been declared float tmp[10,91,180,3] for proper indexing.

4.3.66 CDFhyperPutrVarData

```

int CDFhyperPutrVarData(
void* id,
int varNum,
int recStart,
int recCount,
int recInterval,
int[] indices,
int[] counts,
int[] intervals,
TYPE buffer);
/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- rVariable number. */
/* in -- Starting record number. */
/* in -- Number of records. */
/* in -- Writing interval between records. */
/* in -- Dimension indices of starting value. */
/* in -- Number of values along each dimension. */
/* in -- Writing intervals along each dimension. */
/* in -- Buffer of values. */
/* TYPE -- void*, string or object. */

```

CDFhyperPutrVarData is used to write one or more values from the data holding buffer to the specified rVariable. It is important to know the variable majority of the CDF before using this method because the values in the data buffer will be written using that majority. CDFinquireCDF can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities.

The record number starts at 0, not 1. For example, if you want to write 2 records (10th and 11th record), the starting record number (recStart), the number of records to write (recCount), and the record interval (recInterval) should be 9, 2, and 1, respectively. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

The arguments to CDFhyperPutrVarData are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number to which write data. This number may be determined with a call to CDFgetVarNum.
recStart	Record number at which to start writing.
recCount	Number of records to write.
recInterval	The interval between records for writing (e.g., an interval of 2 means write every other record).
indices	The indices (within each record) at which to start writing. Each element of indices specifies the corresponding dimension index. For 0-dimensional rVariable this argument is ignored (but must be present).
counts	Number of values along each dimension to write. Each element of counts specifies the corresponding dimension count. For 0-dimensional rVariable this argument is ignored (but must be present).
intervals	For each dimension, the interval between values for writing (e.g., an interval of 2 means write every other value). Each element of intervals specifies the corresponding dimension interval. For 0-dimensional rVariable this argument is ignored (but must be present).
buffer	The data holding buffer of values to write. The majority of the values in this buffer must be the same as that of the CDF. The values starting at memory address buffer are written to the CDF.

4.3.66.1. Example(s)

The following example writes 2 records to a rVariable named LATITUDE that is a 1-dimensional array with dimension sizes [181]. The dimension variances are [VARY], and the data type is CDF_INT2. This example is similar to the CDFputrVarData example except that it uses a single call to CDFhyperPutrVarData rather than numerous calls to CDFputrVarData.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
short lat;           /* Latitude value. */
short[, ]  lats = new short[2,181]; /* Buffer of latitude values. */

```

```

int  varN;                /* rVariable number. */
int  recStart = 0;       /* Record number. */
int  recCount = 2;      /* Record counts. */
int  recInterval = 1;   /* Record interval. */
int  indices = new int[] {0}; /* Dimension indices. */
int  counts = new int[] {181}; /* Dimension counts. */
int  intervals = new int[] {1}; /* Dimension intervals. */

.
.
try {
....
    varN = CDFgetVarNum (id, "LATITUDE");
    for (int i=0; i < 2; i++)
        for (lat = -90; lat <= 90; lat++)
            lats[i][90+lat] = (short) lat;

    fixed (void* plats = lats) {
        status = CDFhyperPutrVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals,
                                      plats);
    }
}
Or
...status = CDFhyperPutrVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals, lats);

...
} catch (CDFException ex) {
...
}.

```

4.3.67 CDFhyperPutzVarData

```

int CDFhyperPutzVarData( /* out -- Completion status code. */
void* id,                /* in -- CDF identifier. */
int  varNum,             /* in -- zVariable number. */
int  recStart,           /* in -- Starting record number. */
int  recCount,           /* in -- Number of records. */
int  recInterval,        /* in -- Writing interval between records. */
int[] indices,           /* in -- Dimension indices of starting value. */
int[] counts,            /* in -- Number of values along each dimension. */
int[] intervals,         /* in -- Writing intervals along each dimension. */
TYPE buffer);          /* in -- Buffer of values. */
/* TYPE -- void*, string or object. */

```

CDFhyperPutzVarData is used to write one or more values from the data holding buffer to the specified zVariable. It is important to know the variable majority of the CDF before using this method because the values in the data buffer will be written using that majority. CDFinquireCDF can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities.

The record number starts at 0, not 1. For example, if you want to write 2 records (10th and 11th record), the starting record number (recStart), the number of records to write (recCount), and the record interval (recInterval) should be 9, 2, and 1, respectively. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

The arguments to CDFhyperPutzVarData are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number to which write data. This number may be determined with a call to CDFgetVarNum.
recStart	Record number at which to start writing.
recCount	Number of records to write.
recInterval	The interval between records for writing (e.g., an interval of 2 means write every other record).
indices	The indices (within each record) at which to start writing. Each element of indices specifies the corresponding dimension index. For 0-dimensional zVariable this argument is ignored (but must be present).
counts	Number of values along each dimension to write. Each element of counts specifies the corresponding dimension count. For 0-dimensional zVariable this argument is ignored (but must be present).
intervals	For each dimension, the interval between values for writing (e.g., an interval of 2 means write every other value). Each element of intervals specifies the corresponding dimension interval. For 0-dimensional zVariable this argument is ignored (but must be present).
buffer	The data holding buffer of values to write. The majority of the values in this buffer must be the same as that of the CDF. The values starting at memory address buffer are written to the CDF.

4.3.67.1. Example(s)

The following example writes 2 records to a zVariable named LATITUDE that is a 1-dimensional array with dimension sizes [181]. The dimension variances are [VARY], and the data type is CDF_INT2. This example is similar to the CDFputzVarData example except that it uses a single call to CDFhyperPutzVarData rather than numerous calls to CDFputzVarData.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
short lat;           /* Latitude value. */
short[,] lats = new short[2,181]; /* Buffer of latitude values. */
int  varN;           /* zVariable number. */
int  recStart = 0;   /* Record number. */
int  recCount = 2;  /* Record counts. */
int  recInterval = 1; /* Record interval. */
int  indices = new int[] {0}; /* Dimension indices. */
int  counts = new int[] {181}; /* Dimension counts. */
int  intervals = new int[] {1}; /* Dimension intervals. */
.
```

```

try {
....
    varN = CDFgetVarNum (id, "LATITUDE");
    for (int i= 0; i < 2; i++)
        for (lat = -90; lat <= 90; lat++)
            lats[i][90+lat] = (short) lat;

    fixed (void* plats = lats) {
        status = CDFHyperPutzVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals,
                                     plats);
    }
Or
...status = CDFHyperPutzVarData (id, varN, recStart, recCount, recInterval, indices, counts, intervals, lats);

...
} catch (CDFException ex) {
    ...
}.

```

4.3.68 CDFinquirerVar

```

int CDFinquirezVar(                                     /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
int varNum,                                          /* in -- rVariable number. */
out string varName,                                  /* out -- rVariable name. */
TYPE dataType,                                       /* out -- Data type. */
TYPE numElements,                                    /* out -- Number of elements (of the data type). */
TYPE numDims,                                        /* out -- Number of dimensions. */
TYPE2 dimSizes,                                     /* out -- Dimension sizes */
TYPE recVariance,                                    /* out -- Record variance. */
TYPE2 dimVariances);                                /* out -- Dimension variances. */
/* TYPE -- int* or "out int". */
/* TYPE2 -- int* or "out int[]". */

```

CDFinquirerVar is used to inquire about the specified rVariable. This method would normally be used before reading rVariable values (with CDFgetrVarData or CDFhyperGetrVarData) to determine the data type and number of elements of that data type.

The arguments to CDFinquirezVar are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	Number of the rVariable to inquire. This number may be determined with a call to CDFgetVarNum (see Section 4.3.40).
varName	rVariable's name.
dataType	Data type of the rVariable. The data types are defined in Section 2.6.

numElements	Number of elements of the data type at each rVariable value. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string. (Each value consists of the entire string.) For all other data types, this will always be one (1) - multiple elements at each value are not allowed for non-character data types.
numDims	Number of dimensions.
dimSizes	Dimension sizes. It is a 1-dimensional array, containing one element per dimension. Each element of dimSizes receives the corresponding dimension size. For 0-dimensional zVariables this argument is ignored (but must be present).
recVariance	Record variance. The record variances are defined in Section 2.10.
dimVariances	Dimension variances. Each element of dimVariances receives the corresponding dimension variance. The dimension variances are described in Section 2.10. For 0-dimensional zVariables this argument is ignored (but a placeholder is necessary).

4.3.68.1. Example(s)

The following example returns information about a rVariable named HEAT_FLUX in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    varName;     /* rVariable name. */
int  dataType;       /* Data type of the rVariable. */
int  numElems;       /* Number of elements (of data type). */
int  recVary;        /* Record variance. */
int  numDims;        /* Number of dimensions. */
int[] dimSizes;      /* Dimension sizes */
int[] dimVarys;      /* Dimension variances */
.
.
try {
....
    dimSizes = new int[CDF_MAX_DIMS];
    dimVarys = new int[CDF_MAX_DIMS];
    fixed (int* pdimSizes = dimSizes, pdimVarys = dimVarys) {
        status = CDFinquirerVar(id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, &dataType,
                                &numElems, &numDims, pdimSizes, &recVary, pdimVarys);
    }
}
Or
    status = CDFinquirerVar(id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, out dataType,
                            out numElems, out numDims, out dimSizes, out recVary, out dimVarys);
...
...
} catch (CDFException ex) {
...
}.

```

4.3.69 CDFinquirezVar

```
int CDFinquirezVar(                                     /* out -- Completion status code. */
void* id,                                              /* in -- CDF identifier. */
int varNum,                                           /* in -- zVariable number. */
out string varName,                                   /* out -- zVariable name. */
TYPE dataType,                                       /* out -- Data type. */
TYPE numElements,                                    /* out -- Number of elements (of the data type). */
TYPE numDims,                                        /* out -- Number of dimensions. */
TYPE2 dimSizes,                                     /* out -- Dimension sizes */
TYPE recVariance,                                   /* out -- Record variance. */
TYPE2 dimVariances);                               /* out -- Dimension variances. */
                                                    /* TYPE -- int* or "out int". */
                                                    /* TYPE2 -- int* or "out int[]". */
```

CDFinquirezVar is used to inquire about the specified zVariable. This method would normally be used before reading zVariable values (with CDFgetzVarData or CDFhyperGetzVarData) to determine the data type and number of elements of that data type.

The arguments to CDFinquirezVar are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	Number of the zVariable to inquire. This number may be determined with a call to CDFgetVarNum (see Section 4.3.40).
varName	zVariable's name.
dataType	Data type of the zVariable. The data types are defined in Section 2.6.
numElements	Number of elements of the data type at each zVariable value. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string. (Each value consists of the entire string.) For all other data types, this will always be one (1) - multiple elements at each value are not allowed for non-character data types.
numDims	Number of dimensions.
dimSizes	Dimension sizes. It is a 1-dimensional array, containing one element per dimension. Each element of dimSizes receives the corresponding dimension size. For 0-dimensional zVariables this argument is ignored (but must be present).
recVariance	Record variance. The record variances are defined in Section 2.10.
dimVariances	Dimension variances. Each element of dimVariances receives the corresponding dimension variance. The dimension variances are described in Section 2.10. For 0-dimensional zVariables this argument is ignored (but a placeholder is necessary).

4.3.69.1. Example(s)

The following example returns information about an zVariable named HEAT_FLUX in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
string    varName;     /* zVariable name. */
int  dataType;        /* Data type of the zVariable. */
int  numElems;        /* Number of elements (of data type). */
int  recVary;         /* Record variance. */
int  numDims;         /* Number of dimensions. */
int[] dimSizes;       /* Dimension sizes */
int[] dimVarys;       /* Dimension variances */
.
.
try {
    ....
    dimSizes = new int[CDF_MAX_DIMS];
    dimVarys = new int[CDF_MAX_DIMS];
    fixed (int* pdimSizes = dimSizes, pdimVarys = dimVarys) {
        status = CDFinquirezVar(id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, &dataType,
                                &numElems, &numDims, pdimSizes, &recVary, pdimVarys);
    }
}
Or
status = CDFinquirezVar(id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, out dataType,
                        out numElems, out numDims, out dimSizes, out recVary, out dimVarys);
...
} catch (CDFException ex) {
    ...
}.

```

4.3.70 CDFptrVarData

```

int CDFptrVarData(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
int varNum,                /* in -- Variable number. */
int recNum,                /* in -- Record number. */
int[] indices,             /* in -- Dimension indices. */
TYPE value);              /* in -- Data value. */
                          /* TYPE -- void*, string or object. */

```

CDFptrVarData writes a single data value to the specified index, the location of the element, in the given record of the specified rVariable in a CDF.

The arguments to CDFptrVarData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.

recNum	Record number.
indices	Dimension indices within the record.
value	Data value.

4.3.70.1. Example(s)

The following example will write two data values, the first and the fifth element, in Record 0 from rVariable “MY_VAR”, a 2-dimensional (2 by 3), CDF_DOUBLE type variable, in a row-major CDF. The first put operation passes the pointer of the data value, while the second operation passes the data value as an object.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int  recNum;          /* The record number. */
int[] indices = new int[2]; /* The dimension indices. */
double  value1, value2; /* The data values. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    value1 = 10.1;
    status = CDFputrVarData (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    value2 = 20.2;
    status = CDFputrVarData (id, varNum, recNum, indices, value2);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.71 CDFputrVarPadValue

```

int CDFputrVarPadValue(          /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
int varNum,                     /* in -- Variable number. */
TYPE value);                   /* in -- Pad value. */
/* TYPE -- void*, string or object */

```

CDFputrVarPadValue specifies the pad value for the specified rVariable in a CDF. A rVariable's pad value may be specified (or respecified) at any time without affecting already written values (including where pad values were used). The Concepts chapter in the CDF User's Guide describes variable pad values.

The arguments to CDFputrVarPadValue are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
value	Pad value.

4.3.71.1. Example(s)

The following example sets the pad value to -9999 for rVariable "MY_VAR", a CDF_INT4 type variable, and "*****" for another rVariable "MY_VAR2", a CDF_CHAR type with a number of elements of five (5), in a CDF.

```
.
.
.
void*      id;                /* CDF identifier. */
int  padValue1 = -9999;      /* An int pad value. */
string  padValue2 = "*****"; /* A string pad value. */
.
.
try {
    ....
    status = CDFputrVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), padValue1);
    Or
    status = CDFputrVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), &padValue1);

    status = CDFputrVarPadValue (id, CDFgetVarNum (id, "MY_VAR2"), padValue2);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.72 CDFputrVarRecordData

```
int CDFputrVarRecordData(                /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
int varNum,                              /* in -- Variable number. */
int recNum,                              /* in -- Record number. */
TYPE buffer);                            /* in -- Record data. */
/* TYPE -- void*, string, string[] or object.*/"
```

CDFputrVarRecordData writes an entire record at a given record number for the specified rVariable in a CDF. The buffer should hold the entire data values for the variable. The data values in the buffer should be in the order that corresponds to the variable majority defined for the CDF.

The arguments to CDFputrVarRecordData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recNum	Record number.
buffer	The buffer holding the entire record values.

4.3.72.1. Example(s)

The following example will write one full record (numbered 2) from rVariable “MY_VAR”, a 2-dimension (2 by 3), CDF_INT4 type variable, in a CDF. The variable’s dimension variances are all VARY.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int[,] buffer = new[2,3] {{1,2,3},{4,5,6}}; /* The data holding buffer. */
.
.
try {
....
    varNum = CDFvarNum(id,"MY_VAR");
    status = CDFputrVarRecordData(id, varNum, 2, buffer);
Or
    fixed (void* pBuffer = buffer) {
        status = CDFputrVarRecordData(id, varNum, 2, pBuffer);
    }
...
...
} catch (CDFException ex) {
....
}.

```

4.3.73 CDFputrVarSeqData

```

int CDFputrVarSeqData(
void* id,
int varNum,
TYPE value);
/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- Variable number. */
/* in -- Data value. */
/* TYPE -- void*, string or object. */

```

CDFputrVarSeqData writes one value to the specified rVariable in a CDF at the current sequential value (position) for that variable. After the write, the current sequential value is automatically incremented to the next value. Use CDFsetrVarSeqPos method to set the current sequential value (position).

The arguments to CDFputrVarSeqData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
value	The buffer holding the data value.

4.3.73.1. Example(s)

The following example will write two data values starting at record number 2 from a 2-dimensional rVariable whose data type is CDF_INT4. The first write will pass in a pointer from the data value, while the second write will pass in the data value object directly.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* The variable number. */
int  value1, value2;  /* The data value. */
int[] indices = new int[2]; /* The indices in a record. */
int  recNum;         /* The record number. */
.
.
recNum = 2;
indices[0] = 1;
indices[1] = 2;
try {
    ....
    value1 = 10;
    value2 = -20.
    status = CDFsetrVarSeqPos (id, varNum, recNum, indices);
    status = CDFputrVarSeqData (id, varNum, &value1);
    status = CDFputrVarSeqData (id, varNum, value2);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.74 CDFputzVarData

```

int CDFputzVarData(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
int varNum,                /* in -- Variable number. */

```

```

int recNum,                               /* in -- Record number. */
int[] indices,                             /* in -- Dimension indices. */
TYPE value);                             /* in -- Data value. */
                                           /* TYPE -- void*, string or object. */

```

CDFputzVarData writes a single data value to the specified index, the location of the element, in the given record of the specified zVariable in a CDF.

The arguments to CDFputzVarData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recNum	Record number.
indices	Dimension indices within the record.
value	Data value.

4.3.74.1. Example(s)

The following example will write two data values, the first and the fifth element, in Record 0 from zVariable “MY_VAR”, a 2-dimensional (2 by 3), CDF_DOUBLE type variable, in a row-major CDF. The first put operation passes the pointer of the data value, while the second operation passes the data value as an object.

```

.
.
.
void*      id;                               /* CDF identifier. */
int  varNum;                               /* zVariable number. */
int  recNum;                               /* The record number. */
int[] indices = new int[2];                /* The dimension indices. */
double  value1, value2;                    /* The data values. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    value1 = 10.1;
    status = CDFputzVarData (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    value2 = 20.2;
    status = CDFputzVarData (id, varNum, recNum, indices, value2);
    ...
    ...
} catch (CDFException ex) {
    ...

```



```
}.
```

4.3.75 CDFputzVarPadValue

```
int CDFputzVarPadValue(                                     /* out -- Completion status code. */  
void* id,                                                  /* in -- CDF identifier. */  
int varNum,                                               /* in -- Variable number. */  
TYPE value);                                             /* in -- Pad value. */  
                                                         /* TYPE -- void*, string or object */
```

CDFputzVarPadValue specifies the pad value for the specified zVariable in a CDF. A zVariable's pad value may be specified (or respecified) at any time without affecting already written values (including where pad values were used). The Concepts chapter in the CDF User's Guide describes variable pad values.

The arguments to CDFputzVarPadValue are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
value	Pad value.

4.3.75.1. Example(s)

The following example sets the pad value to -9999 for zVariable "MY_VAR", a CDF_INT4 type variable, and "*****" for another zVariable "MY_VAR2", a CDF_CHAR type with a number of elements of five (5), in a CDF.

```
.  
. .  
. .  
void*      id;                                           /* CDF identifier. */  
int  padValue1 = -9999;                                  /* An int pad value. */  
string  padValue2 = "*****";                          /* A string pad value. */  
. .  
. .  
try {  
    ....  
    status = CDFputzVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), padValue1);  
    Or  
    status = CDFputzVarPadValue (id, CDFgetVarNum (id, "MY_VAR"), &padValue1);  
  
    status = CDFputzVarPadValue (id, CDFgetVarNum (id, "MY_VAR2"), padValue2);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}. .
```

4.3.76 CDFputzVarRecordData

```
int CDFputzVarRecordData(                                     /* out -- Completion status code. */
void* id,                                                    /* in -- CDF identifier. */
int varNum,                                                 /* in -- Variable number. */
int recNum,                                                 /* in -- Record number. */
TYPE buffer);                                             /* in -- Record data. */
                                                           /* TYPE -- void*, string, string[] or object. */
```

CDFputzVarRecordData writes an entire record at a given record number for the specified zVariable in a CDF. The buffer should hold the entire data values for the variable. The data values in the buffer should be in the order that corresponds to the variable majority defined for the CDF.

The arguments to CDFputzVarRecordData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recNum	Record number.
buffer	The buffer holding the entire record values.

4.3.76.1. Example(s)

The following example will write one full record (numbered 2) from zVariable “MY_VAR”, a 2-dimension (2 by 3), CDF_INT4 type variable, in a CDF. The variable’s dimension variances are all VARY.

```
.
.
.
void*      id;                                             /* CDF identifier. */
int  varNum;                                             /* zVariable number. */
int[,] buffer = new[2,3] {{1,2,3},{4,5,6}};             /* The data holding buffer. */
.
.
try {
....
  varNum = CDFvarNum(id,"MY_VAR");
  status = CDFputzVarRecordData (id, varNum, 2, buffer);
Or
  fixed (void* pBuffer = buffer) {
    status = CDFputzVarRecordData (id, varNum, 2, pBuffer);
  }
...
...
} catch (CDFException ex) {
...
}.
```

4.3.77 CDFputzVarSeqData

```
int CDFputzVarSeqData(                                     /* out -- Completion status code. */
void* id,                                                 /* in -- CDF identifier. */
int varNum,                                              /* in -- Variable number. */
TYPE value);                                           /* in -- Data value. */
                                                    /* TYPE -- void*, string or object. */
```

CDFputzVarSeqData writes one value to the specified zVariable in a CDF at the current sequential value (position) for that variable. After the write, the current sequential value is automatically incremented to the next value. Use CDFsetzVarSeqPos method to set the current sequential value (position).

The arguments to CDFputzVarSeqData are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
value	The buffer holding the data value.

4.3.77.1. Example(s)

The following example will write two data values starting at record number 2 from a 2-dimensional zVariable whose data type is CDF_INT4. The first write will pass in a pointer from the data value, while the second write will pass in the data value object directly.

```
.
.
.
void*      id;                                           /* CDF identifier. */
int  varNum;                                           /* The variable number. */
int  value1, value2;                                    /* The data value. */
int[] indices = new int[2];                             /* The indices in a record. */
int  recNum;                                           /* The record number. */
.
.
recNum = 2;
indices[0] = 1;
indices[1] = 2;
try {
    ....
    value1 = 10;
    value2 = -20.
    status = CDFsetzVarSeqPos (id, varNum, recNum, indices);
    status = CDFputzVarSeqData (id, varNum, &value1);
    status = CDFputzVarSeqData (id, varNum, value2);
    ...
    ...
} catch (CDFException ex) {
```

```
...
}.
```

4.3.78 CDFrenamerVar

```
int CDFrenamerVar(                                     /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
int varNum,                                          /* in -- rVariable number. */
string varName);                                     /* in -- New name. */
```

CDFrenamerVar is used to rename an existing rVariable. A variable (rVariable or zVariable) with the same name must not already exist in the CDF.

The arguments to CDFrenamerVar are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	Number of the rVariable to rename. This number may be determined with a call to CDFgetVarNum.
varName	New rVariable name. This may be at most CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.

4.3.78.1. Example(s)

In the following example the rVariable named TEMPERATURE is renamed to TMP (if it exists). Note that if CDFgetVarNum returns a value less than zero (0) then that value is not an rVariable number but rather an error code.

```
.
.
.
void* id;                                             /* CDF identifier. */
int status;                                          /* Returned status code. */
int varNum;                                          /* zVariable number. */
.
.
try {
....
varNum = CDFgetVarNum (id, "TEMPERATURE");
status = CDFrenamerVar (id, varNum, "TMP");
...
...
} catch (CDFException ex) {
...
}.
```



```
int firstRec, /* in -- First record number. */
int lastRec); /* in -- Last record number. */
```

CDFsetrVarAllocBlockRecords specifies a range of records to be allocated (not written) for the specified rVariable in a CDF. This operation is only applicable to uncompressed rVariable in single-file CDFs. Refer to the CDF User’s Guide for the descriptions of allocating variable records.

The arguments to CDFsetrVarAllocBlockRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
firstRec	The first record number to allocate.
lastRec	The last record number to allocate.

4.3.80.1. Example(s)

The following example allocates 10 records, from record numbered 10 to 19, for rVariable “MY_VAR” in a CDF.

```
.
.
.
void* id; /* CDF identifier. */
int firstRec, lastRec; /* The first/last record numbers. */
.
.
firstRec = 10;
lastRec = 19;
try {
....
status = CDFsetrVarAllocBlockRecords (id, CDFgetVarNum(id, “MY_VAR”), firstRec, lastRec);
...
...
} catch (CDFException ex) {
....
}.
}
```

4.3.81 CDFsetrVarAllocRecords

```
int CDFsetrVarAllocRecords( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int varNum, /* in -- Variable number. */
int numRecs); /* in -- Number of records. */
```

CDFsetrVarAllocRecords specifies a number of records to be allocated (not written) for the specified rVariable in a CDF. The records are allocated beginning at record number zero (0). This operation is only applicable to uncompressed rVariable in single-file CDFs. Refer to the CDF User’s Guide for the descriptions of allocating variable records.

The arguments to CDFsetrVarAllocRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numRecs	Number of records to allocate.

4.3.81.1. Example(s)

The following example allocates 100 records, from record numbered 0 to 99, for rVariable “MY_VAR” in a CDF.

```
.
.
.
void*      id;                /* CDF identifier. */
int  numRecs;                /* The number of records. */
.
.
numRecs = 100;
try {
    ....
    status = CDFsetrVarAllocRecords (id, CDFgetVarNum(id, "MY_VAR"), numRecs);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.82 CDFsetrVarBlockingFactor

```
int CDFsetrVarBlockingFactor( /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int varNum,                  /* in -- Variable number. */
int bf);                     /* in -- Blocking factor. */
```

CDFsetrVarBlockingFactor specifies the blocking factor (number of records allocated) for the specified rVariable in a CDF. Refer to the CDF User’s Guide for a description of the blocking factor.

The arguments to CDFsetrVarBlockingFactor are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
bf	The blocking factor. A value of zero (0) indicates that the default blocking factor is being used.

4.3.82.1. Example(s)

The following example sets the blocking factor to 100 records for rVariable “MY_VAR” in a CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  bf;          /* The blocking factor. */  
. .  
bf = 100;  
try {  
    ....  
    status = CDFsetrVarBlockingFactor (id, CDFgetVarNum(id, “MY_VAR”), bf);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}.  
.
```

4.3.83 CDFsetrVarCacheSize

```
int CDFsetrVarCacheSize(          /* out -- Completion status code. */  
void* id,                        /* in -- CDF identifier. */  
int varNum,                      /* in -- Variable number. */  
int numBuffers);                /* in -- Number of cache buffers. */
```

CDFsetrVarCacheSize specifies the number of cache buffers being for the rVariable in a CDF. This operation is not applicable to a single-file CDF. Refer to the CDF User’s Guide for description about caching scheme used by the CDF library.

The arguments to CDFsetrVarCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
numBuffers	Number of cache buffers.

4.3.83.1. Example(s)

The following example sets the number of cache buffers to 10 for rVariable “MY_VAR” in a CDF.

```
.
```



```

.
.
void*      id;          /* CDF identifier. */
int  numBuffers;      /* The number of cache buffers. */
.
.
numBuffers = 10;
try {
    ....
    status = CDFsetrVarCacheSize (id, CDFgetVarNum(id, "MY_VAR"), numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.84 CDFsetrVarCompression

```

int CDFsetrVarCompression( /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
int varNum,              /* in -- Variable number. */
int cType,               /* in -- Compression type. */
int[] cParms);          /* in -- Compression parameters. */

```

CDFsetrVarCompression specifies the compression type/parameters for the specified rVariable in a CDF. Refer to Section 2.11 for a description of the CDF supported compression types/parameters.

The arguments to CDFsetrVarCompression are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
cType	The compression type.
cParms	The compression parameters.

4.3.84.1. Example(s)

The following example sets the compression to GZIP.6 for rVariable "MY_VAR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  cType;          /* The compression type. */
int[] cParms = new int[1]; /* The compression parameters. */
.
.

```

```

cType = GZIP_COMPRESSION;
cParms[0] = 6;
try {
    ....
    status = CDFsetrVarCompression (id, CDFgetVarNum (id, "MY_VAR"), cType, cParms);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.85 CDFsetrVarDataSpec

```

int CDFsetrVarDataSpec(                                     /* out -- Completion status code. */
void* id,                                                  /* in -- CDF identifier. */
int varNum,                                               /* in -- Variable number. */
int dataType)                                             /* in -- Data type. */

```

CDFsetrVarDataSpec respecifies the data type of the specified rVariable in a CDF. The variable's data type cannot be changed if the new data type is not equivalent (type having a different data size) to the old data type and any values (including the pad value) have been written. Data specifications are considered equivalent if the data types are equivalent. Refer to the CDF User's Guide for equivalent data types.

The arguments to CDFsetrVarDataSpec are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
dataType	New data type.

4.3.85.1. Example(s)

The following example respecifies the data type to CDF_INT2 (from its original CDF_UINT2) for rVariable "MY_VAR" in a CDF.

```

.
.
.
void* id;                                                 /* CDF identifier. */
int dataType;                                            /* The data type. */
.
.
dataType = CDF_INT2;
try {
    ....
    status = CDFsetrVarDataSpec (id, CDFgetVarNum (id, "MY_VAR"), dataType);
    ...
}

```

```

...
} catch (CDFException ex) {
...
}.

```

4.3.86 CDFsetrVarDimVariances

```

int CDFsetrVarDimVariances(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int[] dimVarys);                   /* in -- Dimension variances. */

```

CDFsetrVarDimVariances respecifies the dimension variances of the specified rVariable in a CDF. For 0-dimensional rVariable, this operation is not applicable. The dimension variances are described in Section 2.10.

The arguments to CDFsetrVarDimVariances are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
dimVarys	Dimension variances.

4.3.86.1. Example(s)

The following example resets the dimension variances to true (VARY) and true (VARY) for rVariable “MY_VAR”, a 2-dimensional variable, in a CDF.

```

.
.
.
void* id;          /* CDF identifier. */
int varNum;       /* rVariable number. */
int[] dimVarys = new int[] {VARY, VARY}; /* The dimension variances. */
.
.
try {
...
varNum = CDFgetVarNum (id, “MY_VAR”);
status = CDFsetrVarDimVariances (id, varNum, dimVarys);
...
...
} catch (CDFException ex) {
...
}.

```



```
int varNum,          /* in -- Variable number. */
int recVary);       /* in -- Record variance. */
```

CDFsetrVarRecVariance specifies the record variance of the specified rVariable in a CDF. The record variances are described in Section 2.10.

The arguments to CDFsetrVarRecVariance are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recVary	Record variance.

4.3.88.1. Example(s)

The following example sets the record variance to VARY (from NOVARY) for rVariable “MY_VAR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  recVary;         /* The record variance. */
.
.
recVary = VARY;
try {
    ....
    status = CDFsetrVarRecVariance (id, CDFgetVarNum (id, "MY_VAR"), recVary);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.89 CDFsetrVarReservePercent

```
int CDFsetrVarReservePercent(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
int percent);                          /* in -- Reserve percentage. */
```

CDFsetrVarReservePercent specifies the compression reserve percentage being used for the specified rVariable in a CDF. This operation only applies to compressed rVariables. Refer to the CDF User’s Guide for a description of the reserve scheme used by the CDF library.

The arguments to CDFsetrVarReservePercent are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
percent	The reserve percentage.

4.3.89.1. Example(s)

The following example sets the reserve percentage to 10 for rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  percent;         /* The reserve percentage. */
.
.
percent = 10;
try {
    ....
    status = CDFsetVarReservePercent (id, CDFgetVarNum (id, “MY_VAR”), percent);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.

```

4.3.90 CDFsetVarsCacheSize

```

int CDFsetVarsCacheSize(          /* out -- Completion status code. */
void* id,                        /* in -- CDF identifier. */
int numBuffers);                 /* in -- Number of cache buffers. */

```

CDFsetVarsCacheSize specifies the number of cache buffers to be used for all of the rVariable files in a CDF. This operation is not applicable to a single-file CDF. The Concepts chapter in the CDF User's Guide describes the caching scheme used by the CDF library.

The arguments to CDFsetVarsCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numBuffers	Number of buffers.

4.3.90.1. Example(s)

The following example sets the number of cache buffers to 10 for all rVariables in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  numBuffers;      /* The number of cache buffers. */
.
.
numBuffers = 10;
try {
    ....
    status = CDFsetrVarsCacheSize (id, numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.91 CDFsetrVarSeqPos

```
int CDFsetrVarSeqPos(          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int varNum,                  /* in -- Variable number. */
int recNum,                  /* in -- Record number. */
int[] indices);              /* in -- Indices in a record. */
```

CDFsetrVarSeqPos specifies the current sequential value (position) for sequential access for the specified rVariable in a CDF. Note that a current sequential value is maintained for each rVariable individually. Use CDFgetrVarSeqPos method to get the current sequential value.

The arguments to CDFsetrVarSeqPos are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
recNum	rVariable record number.
indices	Dimension indices. Each element of indices receives the corresponding dimension index. For 0-dimensional rVariable, this argument is ignored, but must be presented.

4.3.91.1. Example(s)

The following example sets the current sequential value to the first value element in record number 2 for a rVariable, a 2-dimensional variable, in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* The variable number. */
int  recNum;          /* The record number. */
int[] indices = new int[2]; /* The indices. */
.
.
recNum = 2;
indices[0] = 0;
indices[1] = 0;
try {
    status = CDFsetrVarSeqPos (id, varNum, recNum, indices);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.92 CDFsetrVarSparseRecords

```

int CDFsetrVarSparseRecords(          /* out -- Completion status code. */
void* id,                            /* in -- CDF identifier. */
int varNum,                          /* in -- The variable number. */
int sRecordsType);                  /* in -- The sparse records type. */

```

CDFsetrVarSparseRecords specifies the sparse records type of the specified rVariable in a CDF. Refer to Section 2.12.1 for the description of sparse records.

The arguments to CDFsetrVarSparseRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	rVariable number.
sRecordsType	The sparse records type.

4.3.92.1. Example(s)

The following example sets the sparse records type to PAD_SPARSERECORDS from its original type for rVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  sRecordsType;     /* The sparse records type. */
.

```



```

.
sRecordsType = PAD_ SPARSERECORDS;
try {
    status = CDFsetzVarSparseRecords (id, CDFgetVarNum(id, "MY_VAR"), sRecordsType);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.93 CDFsetzVarAllocBlockRecords

```

int CDFsetzVarAllocBlockRecords(          /* out -- Completion status code. */
void* id,                                /* in -- CDF identifier. */
int varNum,                              /* in -- Variable number. */
int firstRec,                            /* in -- First record number. */
int lastRec);                            /* in -- Last record number. */

```

CDFsetzVarAllocBlockRecords specifies a range of records to be allocated (not written) for the specified zVariable in a CDF. This operation is only applicable to uncompressed zVariable in single-file CDFs. Refer to the CDF User's Guide for the descriptions of allocating variable records.

The arguments to CDFsetzVarAllocBlockRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
firstRec	The first record number to allocate.
lastRec	The last record number to allocate.

4.3.93.1. Example(s)

The following example allocates 10 records, from record numbered 10 to 19, for zVariable "MY_VAR" in a CDF.

```

.
.
.
void* id;                                /* CDF identifier. */
int firstRec, lastRec;                  /* The first/last record numbers. */
.
.
firstRec = 10;
lastRec = 19;
try {
    ....
    status = CDFsetzVarAllocBlockRecords (id, CDFgetVarNum(id, "MY_VAR"), firstRec, lastRec);
    ...
}

```

```

...
} catch (CDFException ex) {
...
}.

```

4.3.94 CDFsetzVarAllocRecords

```

int CDFsetzVarAllocRecords(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int numRecs);                      /* in -- Number of records. */

```

CDFsetzVarAllocRecords specifies a number of records to be allocated (not written) for the specified zVariable in a CDF. The records are allocated beginning at record number zero (0). This operation is only applicable to uncompressed zVariable in single-file CDFs. Refer to the CDF User’s Guide for the descriptions of allocating variable records.

The arguments to CDFsetzVarAllocRecords are defined as follows:

- | | |
|---------|---|
| id | Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF. |
| varNum | zVariable number. |
| numRecs | Number of records to allocate. |

4.3.94.1. Example(s)

The following example allocates 100 records, from record numbered 0 to 99, for zVariable “MY_VAR” in a CDF.

```

.
.
.
void* id;                          /* CDF identifier. */
int numRecs;                       /* The number of records. */
.
.
numRecs = 100;
try {
...
status = CDFsetzVarAllocRecords (id, CDFgetVarNum(id, “MY_VAR”), numRecs);
...
...
} catch (CDFException ex) {
...
}.

```

4.3.95 CDFsetzVarBlockingFactor

```
int CDFsetzVarBlockingFactor(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
int bf);                              /* in -- Blocking factor. */
```

CDFsetzVarBlockingFactor specifies the blocking factor (number of records allocated) for the specified zVariable in a CDF. Refer to the CDF User's Guide for a description of the blocking factor.

The arguments to CDFsetzVarBlockingFactor are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
bf	The blocking factor. A value of zero (0) indicates that the default blocking factor is being used.

4.3.95.1. Example(s)

The following example sets the blocking factor to 100 records for zVariable "MY_VAR" in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  bf;             /* The blocking factor. */
.
.
bf = 100;
try {
    ....
    status = CDFsetzVarBlockingFactor (id, CDFgetVarNum(id, "MY_VAR"), bf);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.96 CDFsetzVarCacheSize

```
int CDFsetzVarCacheSize(          /* out -- Completion status code. */
void* id,                         /* in -- CDF identifier. */
int varNum,                       /* in -- Variable number. */
int numBuffers);                 /* in -- Number of cache buffers. */
```

CDFsetzVarCacheSize specifies the number of cache buffers being for the zVariable in a CDF. This operation is not applicable to a single-file CDF. Refer to the CDF User’s Guide for description about caching scheme used by the CDF library.

The arguments to CDFsetzVarCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
numBuffers	Number of cache buffers.

4.3.96.1. Example(s)

The following example sets the number of cache buffers to 10 for zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  numBuffers;      /* The number of cache buffers. */
.
.
numBuffers = 10;
try {
    ...
    status = CDFsetzVarCacheSize (id, CDFgetVarNum(id, "MY_VAR"), numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.97 CDFsetzVarCompression

```

int CDFsetzVarCompression(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int cType,                         /* in -- Compression type. */
int[] cParms);                    /* in -- Compression parameters. */

```

CDFsetzVarCompression specifies the compression type/parameters for the specified zVariable in a CDF. Refer to Section 2.11 for a description of the CDF supported compression types/parameters.

The arguments to CDFsetzVarCompression are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
----	---

varNum	zVariable number.
cType	The compression type.
cParms	The compression parameters.

4.3.97.1. Example(s)

The following example sets the compression to GZIP.6 for zVariable “MY_VAR” in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  cType;          /* The compression type. */
int[] cParms = new int[1]; /* The compression parameters. */
.
.
cType = GZIP_COMPRESSION;
cParms[0] = 6;
try {
    ....
    status = CDFsetzVarCompression (id, CDFgetVarNum (id, “MY_VAR”), cType, cParms);
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.98 CDFsetzVarDataSpec

```

int CDFsetzVarDataSpec(          /* out -- Completion status code. */
void* id,                       /* in -- CDF identifier. */
int varNum,                     /* in -- Variable number. */
int dataType)                  /* in -- Data type. */

```

CDFsetzVarDataSpec respecifies the data type of the specified zVariable in a CDF. The variable’s data type cannot be changed if the new data type is not equivalent (type having a different data size) to the old data type and any values (including the pad value) have been written. Data specifications are considered equivalent if the data types are equivalent. Refer to the CDF User’s Guide for equivalent data types.

The arguments to CDFsetzVarDataSpec are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
dataType	New data type.

4.3.98.1. Example(s)

The following example respecifies the data type to CDF_INT2 (from its original CDF_UINT2) for zVariable “MY_VAR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  dataType;        /* The data type. */
.
.
dataType = CDF_INT2;
try {
    ....
    status = CDFsetzVarDataSpec (id, CDFgetVarNum (id, “MY_VAR”), dataType);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.99 CDFsetzVarDimVariances

```
int CDFsetzVarDimVariances(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int[] dimVarys);                   /* in -- Dimension variances. */
```

CDFsetzVarDimVariances respecifies the dimension variances of the specified zVariable in a CDF. For 0-dimensional zVariable, this operation is not applicable. The dimension variances are described in Section 2.10.

The arguments to CDFsetzVarDimVariances are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
dimVarys	Dimension variances.

4.3.99.1. Example(s)

The following example resets the dimension variances to true (VARY) and true (VARY) for zVariable “MY_VAR”, a 2-dimensional variable, in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* zVariable number. */
int[] dimVarys = new int[] {VARY, VARY}; /* The dimension variances. */
.
.
try {
    ....
    varNum = CDFgetVarNum (id, "MY_VAR");
    status = CDFsetzVarDimVariances (id, varNum, dimVarys);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.100 CDFsetzVarInitialRecs

```

int CDFsetzVarInitialRecs(          /* out -- Completion status code. */
void* id,                          /* in -- CDF identifier. */
int varNum,                        /* in -- Variable number. */
int numRecs);                      /* in -- Number of records. */

```

CDFsetzVarInitialRecs specifies a number of records to initially write to the specified zVariable in a CDF. The records are written beginning at record number 0 (zero). This may be specified only once per zVariable and before any other records have been written to that zVariable. If a pad value has not yet been specified, the default is used (see the Concepts chapter in the CDF User’s Guide). If a pad value has been explicitly specified, that value is written to the records. The Concepts chapter in the CDF User’s Guide describes initial records.

The arguments to CDFsetzVarInitialRecs are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
numRecs	The initially written records.

4.3.100.1 Example(s)

The following example writes the initial 100 records to zVariable “MY_VAR” in a CDF.

```

.
.
..
void*      id;          /* CDF identifier. */
int  varNum;          /* zVariable number. */
int  numRecs          /* The number of records. */

```

```

.
.
try {
    ...
    varNum = CDFgetVarNum (id, "MY_VAR");
    numRecs = 100;
    status = CDFsetzVarInitialRecs (id, varNum, numRecs);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.101 CDFsetzVarRecVariance

```

int CDFsetzVarRecVariance(                                     /* out -- Completion status code. */
void* id,                                                     /* in -- CDF identifier. */
int varNum,                                                  /* in -- Variable number. */
int recVary);                                                /* in -- Record variance. */

```

CDFsetzVarRecVariance specifies the record variance of the specified zVariable in a CDF. The record variances are described in Section 2.10.

The arguments to CDFsetzVarRecVariance are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recVary	Record variance.

4.3.101.1. Example(s)

The following example sets the record variance to VARY (from NOVARY) for zVariable "MY_VAR" in a CDF.

```

.
.
.
void* id;                                                     /* CDF identifier. */
int recVary;                                                 /* The record variance. */
.
.
recVary = VARY;
try {
    ....
    status = CDFsetzVarRecVariance (id, CDFgetVarNum (id, "MY_VAR"), recVary);
    ...
    ...
} catch (CDFException ex) {

```



```
...
}.
```

4.3.102 CDFsetzVarReservePercent

```
int CDFsetzVarReservePercent(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- Variable number. */
int percent);                         /* in -- Reserve percentage. */
```

CDFsetzVarReservePercent specifies the compression reserve percentage being used for the specified zVariable in a CDF. This operation only applies to compressed zVariables. Refer to the CDF User's Guide for a description of the reserve scheme used by the CDF library.

The arguments to CDFsetzVarReservePercent are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
percent	The reserve percentage.

4.3.102.1. Example(s)

The following example sets the reserve percentage to 10 for zVariable "MY_VAR" in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int percent;          /* The reserve percentage. */
.
.
percent = 10;
try {
    ....
    status = CDFsetzVarReservePercent (id, CDFgetVarNum (id, "MY_VAR"), percent);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.103 CDFsetzVarsCacheSize

```

int CDFsetzVarsCacheSize(                               /* out -- Completion status code. */
void* id,                                               /* in -- CDF identifier. */
int numBuffers);                                       /* in -- Number of cache buffers. */

```

CDFsetzVarsCacheSize specifies the number of cache buffers to be used for all of the zVariable files in a CDF. This operation is not applicable to a single-file CDF. The Concepts chapter in the CDF User's Guide describes the caching scheme used by the CDF library.

The arguments to CDFsetzVarsCacheSize are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numBuffers	Number of buffers.

4.3.103.1. Example(s)

The following example sets the number of cache buffers to 10 for all zVariables in a CDF.

```

.
.
.
void* id;                                               /* CDF identifier. */
int numBuffers;                                       /* The number of cache buffers. */
.
.
numBuffers = 10;
try {
    ....
    status = CDFsetzVarsCacheSize (id, numBuffers);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.104 CDFsetzVarSeqPos

```

int CDFsetzVarSeqPos(                               /* out -- Completion status code. */
void* id,                                               /* in -- CDF identifier. */
int varNum,                                           /* in -- Variable number. */
int recNum,                                           /* in -- Record number. */
int[] indices);                                       /* in -- Indices in a record. */

```

CDFsetzVarSeqPos specifies the current sequential value (position) for sequential access for the specified zVariable in a CDF. Note that a current sequential value is maintained for each zVariable individually. Use CDFgetzVarSeqPos method to get the current sequential value.

The arguments to CDFsetzVarSeqPos are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
varNum	zVariable number.
recNum	zVariable record number.
indices	Dimension indices. Each element of indices receives the corresponding dimension index. For 0-dimensional zVariable, this argument is ignored, but must be presented.

4.3.104.1. Example(s)

The following example sets the current sequential value to the first value element in record number 2 for a zVariable, a 2-dimensional variable, in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* The variable number. */
int  recNum;          /* The record number. */
int[] indices = new int[2]; /* The indices. */
.
.
recNum = 2;
indices[0] = 0;
indices[1] = 0;
try {
    status = CDFsetzVarSeqPos (id, varNum, recNum, indices);
    ...
    ...
} catch (CDFException ex) {
    ...
}.

```

4.3.105 CDFsetzVarSparseRecords

```

int CDFsetzVarSparseRecords(          /* out -- Completion status code. */
void* id,                             /* in -- CDF identifier. */
int varNum,                           /* in -- The variable number. */
int sRecordsType);                   /* in -- The sparse records type. */

```

CDFsetzVarSparseRecords specifies the sparse records type of the specified zVariable in a CDF. Refer to Section 2.12.1 for the description of sparse records.

The arguments to CDFsetzVarSparseRecords are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
----	---

varNum zVariable number.
sRecordsType The sparse records type.

4.3.105.1. Example(s)

The following example sets the sparse records type to PAD_SPARSERECORDS from its original type for zVariable “MY_VAR” in a CDF.

```
.
.
.
void*            id;                            /* CDF identifier. */
int    sRecordsType;                         /* The sparse records type. */
.
.
sRecordsType = PAD_SPARSERECORDS;
try {
    status = CDFsetzVarSparseRecords (id, CDFgetVarNum(id, “MY_VAR”), sRecordsType);
    ...
    ...
} catch (CDFException ex) {
    ...
}.
.
```

4.3.106 CDFvarClose¹¹

```
int CDFvarClose(                                /* out -- Completion status code. */
void* id,                                        /* in -- CDF identifier. */
int varNum);                                    /* in -- rVariable number. */
```

CDFvarClose closes the specified rVariable file from a multi-file format CDF. The variable's cache buffers are flushed before the variable's open file is closed. However, the CDF file is still open.

NOTE: You must close all open variable files to guarantee that all modifications you have made will actually be written to the CDF's file(s). If your program exits, normally or otherwise, without a successful call to CDFclose, the CDF's cache buffers are left unflushed.

The arguments to CDFclose are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varNum The variable number for the open rVariable's file. This identifier must have been initialized by a call to CDFgetVarNum.

¹¹ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFcloserVar is the preferred function for it.

4.3.106.1. Example(s)

The following example will close an open rVariable in a multi-file CDF.

```
.  
. .  
. .  
void*      id;          /* CDF identifier. */  
int  status;          /* Returned status code. */  
. .  
. .  
try {  
  
    status = CDFvarClose (id, CDFvarNum (id, "Flux"));  
  
} catch (CDFException ex) {  
    ...  
}.  
}
```

4.3.107 CDFvarCreate¹²

```
int CDFvarCreate(          /* out -- Completion status code. */  
void* id,                /* in -- CDF identifier. */  
string varName,          /* in -- rVariable name. */  
int dataType,           /* in -- Data type. */  
int numElements,        /* in -- Number of elements (of the data type). */  
int recVariance,        /* in -- Record variance. */  
int[] dimVariances,     /* in -- Dimension variances. */  
TYPE varNum);          /* out -- rVariable number. */  
/* TYPE -- int* or "out int". */
```

CDFvarCreate is used to create a new rVariable in a CDF. A variable (rVariable or zVariable) with the same name must not already exist in the CDF.

The arguments to CDFvarCreate are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varName	The name of the rVariable to create. This may be at most CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.
dataType	Data type of the new rVariable. Specify one of the data types defined in Section 2.6.
numElements	Number of elements of the data type at each value. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string (each value consists of the entire string). For all other data types this must always be one (1) - multiple elements at each value are not allowed for non-character data types.

¹² A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFcreatorVar is the preferred function for it.

recVariance	rVariable's record variance. Specify one of the variances defined in Section 2.10.
dimVariances	rVariable's dimension variances. Each element of dimVariances specifies the corresponding dimension variance. For each dimension specify one of the variances defined in Section 2.10. For 0-dimensional rVariables this argument is ignored (but must be present).
varNum	The number assigned to the new rVariable. This number must be used in subsequent CDF function calls when referring to this rVariable. An existing rVariable's number may be determined with the CDFvarNum or CDFgetVarNum function.

4.3.107.1. Example(s)

The following example will create several rVariables in a 2-dimensional CDF.

```

.
.
.
void*      id;                /* CDF identifier. */
Int  status;                  /* Returned status code. */
int  EPOCHrecVary = {VARY};   /* EPOCH record variance. */
int  LATrecVary = {NOVARY};   /* LAT record variance. */
int  LONrecVary = {NOVARY};   /* LON record variance. */
int  TMPrecVary = {VARY};     /* TMP record variance. */
int[] EPOCHdimVarys = new int[] {NOVARY,NOVARY}; /* EPOCH dimension variances. */
int[] LATdimVarys = new int[] {VARY,VARY};      /* LAT dimension variances. */
int[] LONdimVarys = new int[] {VARY,VARY};      /* LON dimension variances. */
int[] TMPdimVarys = new int[] {VARY,VARY};      /* TMP dimension variances. */
int  EPOCHvarNum;            /* EPOCH zVariable number. */
int  LATvarNum;              /* LAT zVariable number. */
int  LONvarNum;              /* LON zVariable number. */
int  TMPvarNum;              /* TMP zVariable number. */
.
.
try {
    ....
    status = CDFvarCreate (id, "EPOCH", CDF_EPOCH, 1,
                          EPOCHrecVary, EPOCHdimVarys, &EPOCHvarNum);

    status = CDFvarCreate (id, "LATITUDE", CDF_INT2, 1,
                          LATrecVary, LATdimVarys, &LATvarNum);

    status = CDFvarCreate (id, "INTITUDE", CDF_INT2, 1,
                          LONrecVary, LONdimVarys, &LONvarNum);

    status = CDFvarCreate (id, "TEMPERATURE", CDF_REAL4, 1,
                          TMPrecVary, TMPdimVarys, &TMPvarNum);

Or
    status = CDFvarCreate (id, "EPOCH", CDF_EPOCH, 1,
                          EPOCHrecVary, EPOCHdimVarys, out EPOCHvarNum);

```

```

status = CDFvarCreate (id, "LATITUDE", CDF_INT2, 1,
                      LATrecVary, LATdimVarys, out LATvarNum);

status = CDFvarCreate (id, "INTITUDE", CDF_INT2, 1,
                      LONrecVary, LONdimVarys, out LONvarNum);

status = CDFvarCreate (id, "TEMPERATURE", CDF_REAL4, 1,
                      TMPrecVary, TMPdimVarys, out TMPvarNum);

.
} catch (CDFException ex) {
  ...
}.

```

4.3.108 CDFvarGet¹³

```

int CDFvarGet(                                     /* out -- Completion status code. */
void* id,                                         /* in -- CDF identifier. */
int varNum,                                       /* in -- rVariable number. */
int recNum,                                       /* in -- Record number. */
int[] indices,                                    /* in -- Dimension indices. */
TYPE value);                                     /* out -- Value. */
/* TYPE -- void*, "out string" or "out object". */

```

CDFvarGet is used to read a single value from an rVariable.

The arguments to CDFvarGet are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varNum	rVariable number from which to read data.
recNum	Record number at which to read.
indices	Dimension indices within the record.
value	Data value read. This buffer must be large enough to hold the value.

4.3.108.1. Example(s)

The following example returns two data values, the first and the fifth element, in Record 0 from an rVariable named MY_VAR, a 2-dimensional (2 by 3) CDF_DOUBLE type variable, in a row-major CDF. The first get operation passes the value pointer, while the second operation uses "out" argument modifier.

```

.
.

```

¹³ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFgetrVarData is the preferred function for it.

```

.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int  recNum;          /* The record number. */
int[] indices = new int[2]; /* The dimension indices. */
double  value1, value2; /* The data values. */
.
.
try {
    ....
    varNum = CDFvarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    status = CDFvarGet (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    object value2o;
    status = CDFvarGet (id, varNum, recNum, indices, out value2o);
    value2 = (double) value2o;
} catch (CDFException ex) {
    ...
}.

```

4.3.109 CDFvarHyperGet¹⁴

```

int CDFvarHyperGet(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
int varNum,                /* in -- rVariable number. */
int recStart,              /* in -- Starting record number. */
int recCount,              /* in -- Number of records. */
int recInterval,           /* in -- Subsampling interval between records. */
int[] indices,             /* in -- Dimension indices of starting value. */
int[] counts,              /* in -- Number of values along each dimension. */
int[] intervals,           /* in -- Subsampling intervals along each dimension. */
TYPE buffer);            /* out -- Values. */
/* TYPE -- void*, "out string", "out string[]" or "out object". */

```

CDFvarHyperGet is used to fill a buffer of one or more values from the specified rVariable. It is important to know the variable majority of the CDF before using CDFvarHyperGet because the values placed into the buffer will be in that majority. CDFinquire can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

4.3.109.1. Example(s)

The following example will read an entire record of data from an rVariable. The CDF's rVariables are 3-dimensional with sizes [180,91,10] and CDF's variable majority is ROW_MAJOR. For the rVariable the record variance is VARY,

¹⁴ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFhyperGetVarData is the preferred function for it.

the dimension variances are [VARY,VARY,VARY], and the data type is CDF_REAL4. This example is similar to the example provided for CDFvarGet except that it uses a single call to CDFvarHyperGet rather than numerous calls to CDFvarGet.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
float[,,]  tmp;        /* Temperature values. */
int  varN;            /* rVariable number. */
int  recStart = 13;   /* Record number. */
int  recCount = 1;    /* Record counts. */
int  recInterval = 1; /* Record interval. */
int[] indices = new int[] {0,0,0}; /* Dimension indices. */
int[] counts = new int[] {180,91,10}; /* Dimension counts. */
int[] intervals = new int[] {1,1,1}; /* Dimension intervals. */
.
.
try {
    varN = CDFgetVarNum (id, "Temperature");
    ...
    tmp = new float[180,91,10];
    fixed (void* ptmp = tmp) {
        status = CDFvarHyperGet (id, varN, recStart, recCount, recInterval, indices, counts, intervals, ptmp);
    }
    Or
    status = CDFvarHyperGet (id, varN, recStart, recCount, recInterval, indices, counts, intervals, out tmp);
} catch (CDFException ex) {
    ...
}.

```

Note that if the CDF's variable majority had been COLUMN_MAJOR, the tmp array would have been declared float tmp[10,91,180] for proper indexing.

4.3.110 CDFvarHyperPut¹⁵

```

int CDFvarHyperPut(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
int varNum,                /* in -- rVariable number. */
int recStart,              /* in -- Starting record number. */
int recCount,              /* in -- Number of records. */
int recInterval,           /* in -- Interval between records. */
int[] indices,             /* in -- Dimension indices of starting value. */
int[] counts,              /* in -- Number of values along each dimension. */
int[] intervals,           /* in -- Interval between values along each dimension. */
TYPE buffer);            /* in -- Buffer of values. */
/* TYPE -- void*, string, string[] or object. */

```

¹⁵ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFhyperPutrVarData is the preferred function for it.

CDFvarHyperPut is used to write one or more values from the data holding buffer to the specified rVariable. It is important to know the variable majority of the CDF before using this routine because the values in the buffer to be written must be in the same majority. CDFinquire can be used to determine the default variable majority of a CDF distribution. The Concepts chapter in the CDF User's Guide describes the variable majorities. **Note:** you need to provide dummy arrays, with at least one (1) element, for indices, counts and intervals for scalar variables.

4.3.110.1. Example(s)

The following example writes values to the rVariable LATITUDE of a CDF that is a 2-dimensional array with dimension sizes [360,181]. For LATITUDE the record variance is NOVARY, the dimension variances are [NOVARY,VARY], and the data type is CDF_INT2. This example is similar to the CDFvarPut example except that it uses a single call to CDFvarHyperPut rather than numerous calls to CDFvarPut.

```

.
.
.
void*      id;          /* CDF identifier. */
Int  status;          /* Returned status code. */
int  lat;            /* Latitude value. */
short[] lats = new short[181]; /* Buffer of latitude values. */
int  varN;          /* rVariable number. */
int  recStart = 0;   /* Record number. */
int  recCount = 1;  /* Record counts. */
int  recInterval = 1; /* Record interval. */
int[] indices = new int[] {0,0}; /* Dimension indices. */
int[] counts = new int[] {1,181}; /* Dimension counts. */
int[] intervals = new int[] {1,1}; /* Dimension intervals. */

.
.
try {
    ....
    varN = CDFvarNum (id, "LATITUDE");
    for (lat = -90; lat <= 90; lat++)
        lats[90+lat] = (short) lat;
    fixed (void* plats = lats) {
        status = CDFvarHyperPut (id, varN, recStart, recCount, recInterval, indices, counts, intervals, plats);
    }
    Or
    status = CDFvarHyperPut (id, varN, recStart, recCount, recInterval, indices, counts, intervals, lats);
    ....
} catch (CDFException ex) {
    ...
}.

```

4.3.111 CDFvarInquire

```

int CDFvarInquire(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */

```

```

int varNum, /* in -- rVariable number. */
out string varName, /* out -- rVariable name. */
TYPE dataType, /* out -- Data type. */
TYPE numElements, /* out -- Number of elements (of the data type). */
TYPE recVariance, /* out -- Record variance. */
TYPE2 dimVariances); /* out -- Dimension variances. */
/* TYPE -- int* or "out int". */
/* TYPE2 -- int* or "out int[]". */

```

CDFvarInquire is used to inquire about the specified rVariable. This method would normally be used before reading rVariable values (with CDFvarGet or CDFvarHyperGet) to determine the data type and number of elements (of that data type).

The arguments to CDFvarInquire are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varNum	Number of the rVariable to inquire. This number may be determined with a call to CDFvarNum (see Section 4.3.112).
varName	rVariable's name.
dataType	Data type of the rVariable. The data types are defined in Section 2.6.
numElements	Number of elements of the data type at each rVariable value. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string. (Each value consists of the entire string.) For all other data types, this will always be one (1) - multiple elements at each value are not allowed for non-character data types.
recVariance	Record variance. The record variances are defined in Section 2.10.
dimVariances	Dimension variances. Each element of dimVariances receives the corresponding dimension variance. The dimension variances are defined in Section 2.10. For 0-dimensional rVariables this argument is ignored (but a placeholder is necessary).

4.3.111.1. Example(s)

The following example returns about an rVariable named HEAT_FLUX in a CDF. Note that the rVariable name returned by CDFvarInquire will be the same as that passed in to CDFgetVarNum.

```

.
.
.
void*      id; /* CDF identifier. */
int status; /* Returned status code. */
string varName; /* rVariable name. */
int dataType; /* Data type of the rVariable. */
int numElems; /* Number of elements (of data type). */
int recVary; /* Record variance. */
int[] dimVarys; /* Dimension variances (allocate to allow the
                maximum number of dimensions). */
.

```

```

.
try {
....
    dimVarys = new int[CDF_MAX_DIMS];
    fixed (int* pdimVarys = dimVarys) {
        status = CDFvarInquire (id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, &dataType,
                                &numElems, &recVary, pdimVarys);
    }
Or
    status = CDFvarInquire (id, CDFgetVarNum(id,"HEAT_FLUX"), out varName, out dataType,
                            out numElems, out recVary, out dimVarys);
...
} catch (CDFException ex) {
...
}.

```

4.3.112 CDFvarNum¹⁶

```

int CDFvarNum(                /* out -- Variable number. */
void* id,                    /* in -- CDF identifier. */
string varName);             /* in -- Variable name. */

```

CDFvarNum is used to determine the number associated with a given variable name. If the variable is found, CDFvarNum returns its variable number - which will be equal to or greater than zero (0). If an error occurs (e.g., the variable does not exist in the CDF), an error code (of type Int) is returned. Error codes are less than zero (0). The returned variable number should be used in the functions of the same variable type, rVariable or zVariable. If it is an rVariable, functions dealing with rVariables should be used. Similarly, functions for zVariables should be used for zVariables.

The arguments to CDFvarNum are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varName	The name of the variable to search. This may be at most CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.

4.3.112.1. Example(s)

In the following example CDFvarNum is used as an embedded function call when inquiring about an rVariable.

```

.
.
.
void*      id;                /* CDF identifier. */
int  status;                  /* Returned status code. */
string    varName;           /* Variable name. */
int  dataType;               /* Data type of the rVariable. */
int  numElements;           /* Number of elements (of the data type). */

```

¹⁶ A legacy CDF function. It used to handle only rVariables. It has been extended to include zVariables. While it is still available in V3.1, CDFgetVarNum is the preferred function for it.

```

int  recVariance;                /* Record variance. */
int[] dimVariances;            /* Dimension variances. */
.
.
try {
    ....
    dimVariances = new int[CDF_MAX_DIMS];
    fixed (int* pdimVariances = dimVariances) {
        status = CDFvarInquire (id, CDFvarNum(id,"LATITUDE"), out varName, &dataType,
                                &numElements, &recVariance, pdimVariances);
    }
}
Or
status = CDFvarInquire (id, CDFvarNum(id,"LATITUDE"), out varName, out dataType,
                        out numElements, out recVariance, out dimVariances);
.
} catch (CDFException ex) {
    ...
}.

```

In this example the rVariable named LATITUDE was inquired. Note that if LATITUDE did not exist in the CDF, the call to CDFgetVarNum would have returned an error code. Passing that error code to CDFvarInquire as an rVariable number would have resulted in CDFvarInquire also returning an error code. Also note that the name written into varName is already known (LATITUDE). In some cases the rVariable names will be unknown - CDFvarInquire would be used to determine them. CDFvarInquire is described in Section 4.3.111.

4.3.113 CDFvarPut¹⁷

```

int CDFvarPut(                /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int varNum,                  /* in -- rVariable number. */
int recNum,                  /* in -- Record number. */
int[] indices,               /* in -- Dimension indices. */
TYPE value);                /* in -- Value. */
                                /* TYPE -- void*, string or object. */

```

CDFvarPut writes a single data value to an rVariable. CDFvarPut may be used to write more than one value with a single call.

The arguments to CDFvarPut are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varNum	rVariable number to which to write. This number may be determined with a call to CDFvarNum.
recNum	Record number at which to write.

¹⁷ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFputrVarData is the preferred function for it.

indices	Dimension indices within the specified record at which to write. Each element of indices specifies the corresponding dimension index. For 0-dimensional variables, this argument is ignored (but must be present).
value	Data value to write.

4.3.113.1. Example(s)

The following example will write two data values (1st and 5th elements) of a 2-dimensional rVariable (2 by 3) named MY_VAR to record number 0.

```

.
.
.
void*      id;          /* CDF identifier. */
int  varNum;          /* rVariable number. */
int  recNum;          /* The record number. */
int[] indices = new int[2]; /* The dimension indices. */
double  value1, value2; /* The data values. */
.
.
try {
....
    varNum = CDFgetVarNum (id, "MY_VAR");
    recNum = 0;
    indices[0] = 0;
    indices[1] = 0;
    value1 = 10.1;
    status = CDFvarPut (id, varNum, recNum, indices, &value1);
    indices[0] = 1;
    indices[1] = 1;
    value2 = 20.2;
    status = CDFvarPut (id, varNum, recNum, indices, value2);
.
} catch (CDFException ex) {
...
}.

```

4.3.114 CDFvarRename¹⁸

```

int CDFvarRename(          /* out -- Completion status code. */
void* id,                 /* in -- CDF identifier. */
int varNum,               /* in -- rVariable number. */
string varName);          /* in -- New name. */

```

CDFvarRename is used to rename an existing rVariable. A variable (rVariable or zVariable) name must be unique.

¹⁸ A legacy CDF function, handling rVariables only. While it is still available in V3.1, CDFrenamerVar is the preferred function for it.

The arguments to CDFvarRename are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varNum	rVariable number to rename. This number may be determined with a call to CDFvarNum.
varName	New rVariable name. The maximum length of the new name is CDF_VAR_NAME_LEN256 characters. Variable names are case-sensitive.

4.3.114.1. Example(s)

In the following example the rVariable named TEMPERATURE is renamed to TMP (if it exists). Note that if CDFvarNum returns a value less than zero (0) then that value is not an rVariable number but rather a warning/error code.

```
.
.
.
void*      id;                /* CDF identifier. */
int  status;                 /* Returned status code. */
int  varNum;                 /* rVariable number. */
.
.
try {
....
    varNum = CDFvarNum (id, "TEMPERATURE");
...
}
.
} catch (CDFException ex) {
...
}.
```

4.4 Attributes/Entries

This section provides functions that are related to CDF attributes or attribute entries. An attribute is identified by its name or an number in the CDF. Before you can perform any operation on an attribute or attribute entry, the CDF in which it resides must be opened.

4.4.1 CDFattrCreate¹⁹

```
int CDFattrCreate(                /* out -- Completion status code. */
void* id,                        /* in -- CDF identifier. */
string attrName,                 /* in -- Attribute name. */
int attrScope,                  /* in -- Scope of attribute. */
TYPE attrNum);                  /* out -- Attribute number. */
```

¹⁹ Same as CDFcreateAttr.

```
/* TYPE -- int* or "out int". */
```

CDFAttrCreate creates an attribute in the specified CDF. An attribute with the same name must not already exist in the CDF.

The arguments to CDFAttrCreate are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrName	The name of the attribute to create. This may be at most CDF_ATTR_NAME_LEN256 characters. Attribute names are case-sensitive.
attrScope	The scope of the new attribute. Specify one of the scopes described in Section 2.13.
attrNum	The number assigned to the new attribute. This number must be used in subsequent CDF function calls when referring to this attribute. An existing attribute's number may be determined with the CDFgetAttrNum function.

4.4.1.1. Example(s)

The following example creates two attributes. The TITLE attribute is created with global scope - it applies to the entire CDF (most likely the title of the data set stored in the CDF). The Units attribute is created with variable scope - each entry describes some property of the corresponding variable (in this case the units for the data).

```
.  
. .  
void*      id;          /* CDF identifier. */  
int  status;          /* Returned status code. */  
string  UNITSattrName = "Units"; /* Name of "Units" attribute. */  
int  UNITSattrNum;    /* "Units" attribute number. */  
int  TITLEattrNum;   /* "TITLE" attribute number. */  
int  TITLEattrScope = GLOBAL_SCOPE; /* "TITLE" attribute scope. */  
. .  
try {  
    ...  
    status = CDFAttrCreate (id, "TITLE", TITLEattrScope, &TITLEattrNum);  
    status = CDFAttrCreate (id, UNITSattrName, VARIABLE_SCOPE, out UNITSattrnum);  
    ...  
    ...  
} catch (CDFException ex) {  
    ...  
}  
. .
```

4.4.2 CDFAttrEntryInquire

```
int CDFAttrEntryInquire( /* out -- Completion status code. */
```



```

void* id,                /* in -- CDF identifier. */
int attrNum,            /* in -- Attribute number. */
int entryNum,          /* in -- Entry number. */
TYPE dataType,        /* out -- Data type. */
TYPE numElements);   /* out -- Number of elements (of the data type). */
                        /* TYPE -- int* or "out int". */

```

CDFattrEntryInquire is used to inquire about a specific attribute entry. To inquire about the attribute in general, use CDFattrInquire. CDFattrEntryInquire would normally be called before calling CDFattrGet in order to determine the data type and number of elements (of that data type) for an entry. This would be necessary to correctly allocate enough memory to receive the value read by CDFattrGet.

The arguments to CDFattrEntryInquire are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrNum	Attribute number for which to inquire an entry. This number may be determined with a call to CDFattrNum (see Section 4.4.5).
entryNum	Entry number to inquire. If the attribute is global in scope, this is simply the gEntry number and has meaning only to the application. If the attribute is variable in scope, this is the number of the associated rVariable (the rVariable being described in some way by the rEntry).
dataType	Data type of the specified entry. The data types are defined in Section 2.6.
NumElements	Number of elements of the data type. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string (An array of characters). For all other data types this is the number of elements in an array of that data type.

4.4.2.1. Example(s)

The following example returns each entry for an attribute. Note that entry numbers need not be consecutive - not every entry number between zero (0) and the maximum entry number must exist. For this reason NO_SUCH_ENTRY is an expected error code. Note also that if the attribute has variable scope, the entry numbers are actually rVariable numbers.

```

.
.
.
void*      id;                /* CDF identifier. */
int  status;                /* Returned status code. */
int  attrN;                /* attribute number. */
int  entryN;                /* Entry number. */
string  attrName;          /* attribute name. */
int  attrScope;            /* attribute scope. */
int  maxEntry;            /* Maximum entry number used. */
int  dataType;            /* Data type. */
int  numElems;            /* Number of elements (of the data type). */
.
.
try {
    ...

```

```

attrN = CDFgetAttrNum (id, "TMP");
status = CDFattrInquire (id, attrN, out attrName, &attrScope, &maxEntry);

for (entryN = 0; entryN <= maxEntry; entryN++) {
    status = CDFattrEntryInquire (id, attrN, entryN, &dataType, &numElems);
    Or
    status = CDFattrEntryInquire (id, attrN, entryN, out dataType, out numElems);
    .
    .
}
...
} catch (CDFException ex) {
    ...
}

```

4.4.3 CDFattrGet²⁰

```

int CDFattrGet(                                     /* out -- Completion status code. */
void* id,                                          /* in -- CDF identifier. */
int attrNum,                                       /* in -- Attribute number. */
int entryNum,                                       /* in -- Entry number. */
TYPE value);                                       /* out -- Attribute entry value. */
                                                    /* TYPE -- void*, "out string" or "out object". */

```

CDFattrGet is used to read an attribute entry from a CDF. In most cases it will be necessary to call CDFattrEntryInquire before calling CDFattrGet in order to determine the data type and number of elements (of that data type) for the entry.

The arguments to CDFattrGet are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrNum	Attribute number. This number may be determined with a call to CDFattrNum (Section 4.4.5).
entryNum	Entry number. If the attribute is global in scope, this is simply the gEntry number and has meaning only to the application. If the attribute is variable in scope, this is the number of the associated rVariable (the rVariable being described in some way by the rEntry).
value	Value read. This buffer must be large enough to hold the value. The method CDFattrEntryInquire would be used to determine the entry data type and number of elements (of that data type). The value is read from the CDF and placed into memory at address value.

4.4.3.1. Example(s)

The following example displays the value of the UNITS attribute for the rEntry corresponding to the PRES_LVL rVariable (but only if the data type is CDF_CHAR).

²⁰ A legacy CDF function. While it is still available in V3.1, CDFgetAttrEntry or CDFgetAttrEntry is the preferred function for it.

```

.
.
.
void*      id;          /* CDF identifier. */
Int  status;          /* Returned status code. */
int      attrN;       /* Attribute number. */
int      entryN;     /* Entry number. */
int      dataType;   /* Data type. */
int      numElems;   /* Number of elements (of data type). */
.
.
try {
...
attrN = CDFattrNum (id, "UNITS");
entryN = CDFvarNum (id, "PRES_LVL"); /* The rEntry number is the rVariable number. */

status = CDFattrEntryInquire (id, attrN, entryN, out dataType, out numElems);

if (dataType == CDF_CHAR) {
    string buffer;
    status = CDFattrGet (id, attrN, entryN, out buffer);
}
} catch (CDFException ex) {
...
}.
.

```

4.4.4 CDFattrInquire²¹

```

int CDFattrInquire(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
int attrNum,               /* in -- Attribute number. */
out string attrName,      /* out -- Attribute name. */
TYPE attrScope,          /* out -- Attribute scope. */
TYPE maxEntry);          /* out -- Maximum gEntry/rEntry number. */
                          /* TYPE -- int* or "out int". */

```

CDFattrInquire is used to inquire about the specified attribute. To inquire about a specific attribute entry, use CDFattrEntryInquire.

The arguments to CDFattrInquire are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrNum	Number of the attribute to inquire. This number may be determined with a call to CDFattrNum (see Section 4.4.5).
attrName	Attribute's name. This string length is limited to CDF_ATTR_NAME_LEN256.

²¹ A legacy function. While it is still available in V3.1, CDFinquireAttr is the preferred function for it.

attrScope	Scope of the attribute. Attribute scopes are defined in Section 2.13.
maxEntry	For gAttributes this is the maximum gEntry number used. For vAttributes this is the maximum rEntry number used. In either case this may not correspond with the number of entries (if some entry numbers were not used). If no entries exist for the attribute, then a value of -1 will be passed back.

4.4.4.1. Example(s)

The following example displays the name of each attribute in a CDF. The number of attributes in the CDF is first determined using the method CDFinquire. Note that attribute numbers start at zero (0) and are consecutive.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numDims;        /* Number of dimensions. */
int[] dimSizes;      /* Dimension sizes (allocate to allow the maximum
                    number of dimensions). */

int  encoding;       /* Data encoding. */
int  majority;      /* Variable majority. */
int  maxRec;        /* Maximum record number in CDF. */
int  numVars;       /* Number of variables in CDF. */
int  numAttrs;      /* Number of attributes in CDF. */
int  attrN;         /* attribute number. */
string  attrName;   /* attribute name. */
int  attrScope;    /* attribute scope. */
int  maxEntry;     /* Maximum entry number. */
.
.
try {
    ....
    status = CDFinquire (id, out numDims, out dimSizes, out encoding, out majority, out maxRec, out numVars,
                       out numAttrs);
    for (attrN = 0; attrN < numAttrs; attrN++) {
        status = CDFattrInquire (id, attrN, out attrName, out attrScope, out maxEntry);
        Or
        status = CDFattrInquire (id, attrN, out attrName, &attrScope, &maxEntry);
    }
} catch (CDFException ex) {
    ...
}
.

```

4.4.5 CDFattrNum²²

```
int CDFattrNum(          /* out -- attribute number. */
```

²² A legacy CDF function. While it is still available in V3.1, CDFgetAttrNum is the preferred function for it.

```
void* id, /* in -- CDF id */
string attrName); /* in -- Attribute name */
```

CDFAttrNum is used to determine the attribute number associated with a given attribute name. If the attribute is found, CDFAttrNum returns its number - which will be equal to or greater than zero (0). If an error occurs (e.g., the attribute name does not exist in the CDF), an error code (of type Int) is returned. Error codes are less than zero (0).

The arguments to CDFAttrNum are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrName	Name of the attribute for which to search. This may be at most CDF_ATTR_NAME_LEN256 characters. Attribute names are case-sensitive.

CDFAttrNum may be used as an embedded function call when an attribute number is needed.

4.4.5.1. Example(s)

In the following example the attribute named pressure will be renamed to PRESSURE with CDFAttrNum being used as an embedded function call. Note that if the attribute pressure did not exist in the CDF, the call to CDFAttrNum would have returned an error code. Passing that error code to CDFAttrRename as an attribute number would have resulted in CDFAttrRename also returning an error code.

```
.
.
.
void* id; /* CDF identifier. */
int status; /* Returned status code. */
.
.
try {
....
status = CDFAttrRename (id, CDFAttrNum(id,"pressure"), "PRESSURE");
....
} catch (CDFException ex) {
....
}
}
```

4.4.6 CDFAttrPut

```
int CDFAttrPut( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int attrNum, /* in -- Attribute number. */
int entryNum, /* in -- Entry number. */
int dataType, /* in -- Data type of this entry. */
int numElements, /* in -- Number of elements (of the data type). */
TYPE value); /* in -- Attribute entry value. */
/* TYPE -- void*, string, string[] or object. */
```



```

    }
} catch (CDFException ex) {
    ...
}.
.

```

4.4.7 CDFAttrRename²³

```

int CDFAttrRename(                                     /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
int attrNum,                                         /* in -- Attribute number. */
string attrName);                                    /* in -- New attribute name. */

```

CDFAttrRename is used to rename an existing attribute. An attribute with the new name must not already exist in the CDF.

The arguments to CDFAttrRename are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
attrNum	Number of the attribute to rename. This number may be determined with a call to CDFAttrNum (see Section 4.4.5).
attrName	New attribute name. This may be at most CDF_ATTR_NAME_LEN256 characters. Attribute names are case-sensitive.

4.4.7.1. Example(s)

In the following example the attribute named LAT is renamed to LATITUDE.

```

.
.
.
void* id;                                             /* CDF identifier. */
int status;                                          /* Returned status code. */
.
.
try {
    status = CDFAttrRename (id, CDFgetAttrNum(id,"LAT"), "LATITUDE");
.
} catch (CDFException ex) {
    ...
}.

```

²³ A legacy CDF function. While it is still available in V3.1, CDFrenameAttr is the preferred function for it.

CDFconfirmgEntryExistence confirms the existence of the specified entry (gEntry), in a global attribute from a CDF. If the gEntry does not exist, the informational status code NO_SUCH_ENTRY will be returned and no exception is thrown.

The arguments to CDFconfirmgEntryExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Global attribute number.

entryNum gEntry number.

4.4.9.1. Example(s)

The following example checks the existence of a gEntry numbered 1 for attribute “MY_ATTR” in a CDF.

```

.
.
.
void*        id;                            /* CDF identifier. */
int   status;                            /* Returned status code. */
int   attrNum;                           /* Attribute number. */
int   entryNum;                         /* gEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum(id, "MY_ATTR");
    entryNum = 1;
    status = CDFconfirmgEntryExistence (id, attrNum, entryNum);
    if (status == NO_SUCH_ENTRY) UserStatusHandler (status);
.
.

```

4.4.10 CDFconfirmrEntryExistence

```

int CDFconfirmrEntryExistence(                            /* out -- Completion status code. */
void* id,                                                 /* in -- CDF identifier. */
int attrNum,                                             /* in -- Attribute number. */
int entryNum);                                           /* in -- rEntry number. */

```

CDFconfirmrEntryExistence confirms the existence of the specified entry (rEntry), corresponding to an rVariable, in a variable attribute from a CDF. If the rEntry does not exist, the informational status code NO_SUCH_ENTRY will be returned and no exception is thrown.

The arguments to CDFconfirmrEntryExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Variable attribute number.

entryNum rEntry number.

4.4.10.1. Example(s)

The following example checks the existence of an rEntry, corresponding to rVariable “MY_VAR”, for attribute “MY_ATTR” in a CDF.

```
.
.
.
void* id;           /* CDF identifier. */
int status;        /* Returned status code. */
int attrNum;       /* Attribute number. */
int entryNum;      /* rEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum(id, “MY_ATTR”);
    entryNum = CDFgetVarNum(id, “MY_VAR”);
    status = CDFconfirmrEntryExistence (id, attrNum, entryNum);
    if (status == NO_SUCH_ENTRY) UserStatusHandler (status);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.11 CDFconfirmzEntryExistence

```
int CDFconfirmzEntryExistence(           /* out -- Completion status code. */
void* id,                               /* in -- CDF identifier. */
int attrNum,                            /* in -- Attribute number. */
int entryNum);                          /* in -- zEntry number. */
```

CDFconfirmzEntryExistence confirms the existence of the specified entry (zEntry), corresponding to a zVariable, in a variable attribute from a CDF. If the zEntry does not exist, the informational status code NO_SUCH_ENTRY will be returned and no exception is thrown.

The arguments to CDFconfirmzEntryExistence are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Variable attribute number.

entryNum zEntry number.

4.4.11.1. Example(s)

The following example checks the existence of the zEntry corresponding to zVariable “MY_VAR” for the variable attribute “MY_ATTR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
int  entryNum;       /* zEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum(id, “MY_ATTR”);
    entryNum = CDFgetVarNum(id, “MY_VAR”);
    status = CDFconfirmzEntryExistence (id, attrNum, entryNum);
    if (status == NO_SUCH_ENTRY) UserStatusHandler (status);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.12 CDFcreateAttr

```
int CDFcreateAttr(          /* out -- Completion status code. */
void* id,                  /* in -- CDF identifier. */
string attrName,          /* in -- Attribute name. */
int attrScope,           /* in -- Scope of attribute. */
TYPE attrNum);          /* out -- Attribute number. */
                          /* TYPE -- int* or “out int”. */
```

CDFcreateAttr creates an attribute with the specified scope in a CDF. It is identical to the method CDFattrCreate. An attribute with the same name must not already exist in the CDF.

The arguments to CDFcreateAttr are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrName	Name of the attribute to create. This may be at most CDF_ATTR_NAME_LEN256 characters. Attribute names are case-sensitive.
attrScope	Scope of the new attribute. Specify one of the scopes described in Section 2.13.

attrNum Number assigned to the new attribute. This number must be used in subsequent CDF function calls when referring to this attribute. An existing attribute's number may be determined with the CDFgetAttrNum function.

4.4.12.1. Example(s)

The following example creates two attributes. The TITLE attribute is created with global scope - it applies to the entire CDF (most likely the title of the data set stored in the CDF). The Units attribute is created with variable scope - each entry describes some property of the corresponding variable (in this case the units for the data).

```
.
.
.
void*      id;                /* CDF identifier. */
int  status;                 /* Returned status code. */
string    UNITSattrName = "Units"; /* Name of "Units" attribute. */
int      UNITSattrNum;      /* "Units" attribute number. */
int      TITLEattrNum;     /* "TITLE" attribute number. */
int  TITLEattrScope = GLOBAL_SCOPE; /* "TITLE" attribute scope. */
.
.
try {
    ....
    status = CDFcreateAttr (id, "TITLE", TITLEattrScope, &TITLEattrNum);
    status = CDFcreateAttr (id, UNITSattrName, VARIABLE_SCOPE, out UNITSattrnum);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.13 CDFdeleteAttr

```
int CDFdeleteAttr(           /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
int attrNum);              /* in -- Attribute identifier. */
```

CDFdeleteAttr deletes the specified attribute from a CDF.

The arguments to CDFdeleteAttr are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Attribute number to be deleted.

4.4.13.1. Example(s)

The following example deletes an existing attribute named MY_ATTR from a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    status = CDFdeleteAttr (id, attrNum);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.14 CDFdeleteAttrgEntry

```
int CDFdeleteAttrgEntry(          /* out -- Completion status code. */
void* id,                        /* in -- CDF identifier. */
int attrNum,                     /* in -- Attribute identifier. */
int entryNum);                  /* in -- gEntry identifier. */
```

CDFdeleteAttrgEntry deletes the specified entry (gEntry) in a global attribute from a CDF.

The arguments to CDFdeleteAttrgEntry are defined as follows:

- id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
- attrNum Global attribute number from which to delete an attribute entry.
- entryNum gEntry number to delete.

4.4.14.1. Example(s)

The following example deletes the entry number 5 from an existing global attribute MY_ATTR in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
int  entryNum;       /* gEntry number. */
.
```

```

.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    entryNum = 5;
    status = CDFdeleteAttrEntry (id, attrNum, entryNum);
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.15 CDFdeleteAttrEntry

```

int CDFdeleteAttrEntry(                                     /* out -- Completion status code. */
void* id,                                                 /* in -- CDF identifier. */
int attrNum,                                             /* in -- Attribute identifier. */
int entryNum);                                          /* in -- rEntry identifier. */

```

CDFdeleteAttrEntry deletes the specified entry (rEntry), corresponding to an rVariable, in an (variable) attribute from a CDF.

The arguments to CDFdeleteAttrEntry are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Variable attribute number.

entryNum rEntry number.

4.4.15.1. Example(s)

The following example deletes the entry corresponding to rVariable "MY_VAR1" from the variable attribute "MY_ATTR" in a CDF.

```

.
.
.
void*            id;                                     /* CDF identifier. */
int status;                                           /* Returned status code. */
int attrNum;                                          /* Attribute number. */
int entryNum;                                         /* rEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    entryNum = CDFgetVarNum(id, "MY_VAR1");

```

```

        status = CDFdeleteAttrEntry (id, attrNum, entryNum);
    } catch (CDFException ex) {
        ...
    }.
    .

```

4.4.16 CDFdeleteAttrEntry

```

int CDFdeleteAttrEntry(                                     /* out -- Completion status code. */
void* id,                                                  /* in -- CDF identifier. */
int attrNum,                                              /* in -- Attribute identifier. */
int entryNum);                                           /* in -- zEntry identifier. */

```

CDFdeleteAttrEntry deletes the specified entry (zEntry), corresponding to a zVariable, in an (variable) attribute from a CDF.

The arguments to CDFdeleteAttrEntry are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Variable attribute number.

entryNum zEntry number to be deleted that is the zVariable number.

4.4.16.1. Example(s)

The following example deletes the variable attribute entry named MY_ATTR that is attached to the zVariable MY_VAR1.

```

.
.
.
void*        id;                                           /* CDF identifier. */
int    status;                                           /* Returned status code. */
int    attrNum;                                         /* Attribute number. */
int    entryNum;                                        /* zEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    entryNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFdeleteAttrEntry (id, attrNum, entryNum);
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.17 CDFgetAttrgEntry

```
int CDFgetAttrgEntry (                                /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
int attrNum,                                         /* in -- Attribute identifier. */
int entryNum,                                        /* in -- gEntry number. */
TYPE value);                                         /* out -- gEntry data. */
/* TYPE -- void*, "out string" or "out object". */
```

This method is identical to the method CDFattrGet. CDFgetAttrgEntry is used to read a global attribute entry from a CDF. In most cases it will be necessary to call CDFInquireAttrgEntry before calling CDFgetAttrgEntry in order to determine the data type and number of elements (of that data type) for the entry.

The arguments to CDFgetAttrgEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number. This number may be determined with a call to CDFgetAttrNum.
entryNum	Global attribute entry number.
value	Value read.

4.4.17.1. Example(s)

The following example displays the value of the global attribute called HISTORY.

```
.
.
.
void*      id;                                       /* CDF identifier. */
int  status;                                       /* Returned status code. */
int  attrN;                                        /* Attribute number. */
int  entryN;                                       /* Entry number. */
int  dataType;                                    /* Data type. */
int  numElems;                                    /* Number of elements (of data type). */
string  buffer;                                    /* Buffer to receive value. */
.
.
try {
    ....
    attrN = CDFattrNum (id, "HISTORY");
    entryN = 0;
    status = CDFInquireAttrgEntry (id, attrN, entryN, out dataType, out numElems);
    if (dataType == CDF_CHAR) {
        status = CDFgetAttrgEntry (id, attrN, entryN, out buffer);
    }
}
```



```

.
} catch (CDFException ex) {
.
.
}
.

```

4.4.18 CDFgetAttrgEntryDataType

```

int CDFgetAttrgEntryDataType (                               /* out -- Completion status code. */
void* id,                                                    /* in -- CDF identifier. */
int attrNum,                                                /* in -- Attribute identifier. */
int entryNum,                                              /* in -- gEntry number. */
TYPE dataType);                                           /* out -- gEntry data type. */
                                                         /* TYPE -- int* or "out int". */

```

CDFgetAttrgEntryDataType returns the data type of the specified global attribute and gEntry number in a CDF. The data types are described in Section 2.6.

The arguments to CDFgetAttrgEntryDataType are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Global attribute number.
entryNum	gEntry number.
dataType	Data type of the gEntry.

4.4.18.1. Example(s)

The following example gets the data type for the gEntry numbered 2 from the global attribute "MY_ATTR" in a CDF.

```

.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  attrNum;          /* Attribute number. */
int  entryNum;         /* gEntry number. */
int  dataType;         /* gEntry data type. */
.
.
try {
.
.
.
attrNum = CDFgetAttrNum (id, "MY_ATTR");
entryNum = 2;
status = CDFgetAttrgEntryDataType (id, attrNum, entryNum, &dataType);
Or

```

```

        status = CDFgetAttrgEntryDataType (id, attrNum, entryNum, out dataType);
    } catch (CDFException ex) {
        ...
    }.
    .

```

4.4.19 CDFgetAttrgEntryNumElements

```

int CDFgetAttrgEntryNumElements (                                /* out -- Completion status code. */
void* id,                                                        /* in -- CDF identifier. */
int attrNum,                                                    /* in -- Attribute identifier. */
int entryNum,                                                  /* in -- gEntry number. */
TYPE numElems);                                               /* out -- gEntry's number of elements. */
                                                                /* TYPE -- int* or "out int". */

```

CDFgetAttrgEntryNumElements returns the number of elements of the specified global attribute and gentry number in a CDF.

The arguments to CDFgetAttrgEntryNumElements are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Global attribute number.

entryNum gEntry number.

numElems Number of elements of the gEntry.

4.4.19.1. Example(s)

The following example gets the number of elements from the gEntry numbered 2 from the global attribute "MY_ATTR" in a CDF.

```

.
.
.
void*        id;                                                /* CDF identifier. */
int    status;                                                /* Returned status code. */
int    attrNum;                                               /* Attribute number. */
int    entryNum;                                              /* gEntry number. */
int    numElements;                                           /* gEntry's number of elements. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    entryNum = 2;
    status = CDFgetAttrgEntryNumElements (id, attrNum, entryNum, out numElements);
}

```

```

Or
    status = CDFgetAttrgEntryNumElements (id, attrNum, entryNum, &numElements);

.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.20 CDFgetAttrMaxgEntry

```

int CDFgetAttrMaxgEntry (                                /* out -- Completion status code. */
void* id,                                                /* in -- CDF identifier. */
int attrNum,                                            /* in -- Attribute identifier. */
TYPE maxEntry);                                       /* out -- The last gEntry number. */
                                                         /* TYPE -- int* or "out int". */

```

CDFgetAttrMaxgEntry returns the last entry number of the specified global attribute in a CDF.

The arguments to CDFgetAttrMaxgEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Global attribute number.
maxEntry	The last gEntry number.

4.4.20.1. Example(s)

The following example gets the last entry number from the global attribute “MY_ATTR” in a CDF.

```

.
.
.
void*      id;                                         /* CDF identifier. */
int  status;                                          /* Returned status code. */
int  attrNum;                                        /* Attribute number. */
int  maxEntry;                                       /* The last gEntry number. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    status = CDFgetAttrMaxgEntry (id, attrNum, out maxEntry);
Or
    status = CDFgetAttrMaxgEntry (id, attrNum, &maxEntry);
.
} catch (CDFException ex) {
    ...

```

```
}.  
.
```

4.4.21 CDFgetAttrMaxrEntry

```
int CDFgetAttrMaxrEntry (                                /* out -- Completion status code. */  
void* id,                                               /* in -- CDF identifier. */  
int attrNum,                                           /* in -- Attribute identifier. */  
TYPE maxEntry);                                       /* out -- The maximum rEntry number. */  
/* TYPE -- int* or "out int". */
```

CDFgetAttrMaxrEntry returns the last rEntry number (rVariable number) to which the given variable attribute is attached.

The arguments to CDFgetAttrMaxrEntry are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum rVariable attribute number.

maxEntry The last rEntry number (rVariable number) to which attrNum is attached..

4.4.21.1. Example(s)

The following example gets the last entry, corresponding to the last rVariable number, from the variable attribute "MY_ATTR" in a CDF.

```
.  
. .  
. .  
void*        id;                                        /* CDF identifier. */  
int    status;                                        /* Returned status code. */  
int    attrNum;                                      /* Attribute number. */  
int    maxEntry;                                     /* The last rEntry number. */  
. .  
. .  
try {  
    ....  
    attrNum = CDFgetAttrNum (id, "MY_ATTR");  
    status = CDFgetAttrMaxrEntry (id, attrNum, out maxEntry);  
    Or  
    status = CDFgetAttrMaxrEntry (id, attrNum, &maxEntry);  
} catch (CDFException ex) {  
    ...  
}.  
.
```



```

int attrNum,                               /* in -- Attribute identifier. */
out string attrName);                       /* out -- The attribute name. */

```

CDFgetAttrName gets the name of the specified attribute (by its number) in a CDF.

The arguments to CDFgetAttrName are defined as follows:

```

id      Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or
        CDFcreateCDF) or CDFopenCDF.

attrNum Attribute number.

attrName The name of the attribute.

```

4.4.23.1. Example(s)

The following example retrieves the name of the attribute number 2, if it exists, in a CDF.

```

.
.
.
void*      id;                               /* CDF identifier. */
int  status;                                /* Returned status code. */
int  attrNum;                               /* Attribute number. */
string    attrName;                         /* The attribute name. */
.
.
attrNum = 2;
try {
    ....
    status = CDFgetAttrName (id, attrNum, out attrName);
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.24 CDFgetAttrNum

```

int CDFgetAttrNum (                          /* out -- Attribute number. */
void* id,                                    /* in -- CDF identifier. */
string attrName);                            /* in -- The attribute name. */

```

CDFgetAttrNum is used to determine the attribute number associated with a given attribute name. If the attribute is found, CDFgetAttrNum returns its number - which will be equal to or greater than zero (0). If an error occurs (e.g., the attribute name does not exist in the CDF), an error code (of type Int) is returned. Error codes are less than zero (0).

The arguments to CDFgetAttrNum are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrName	The name of the attribute for which to search. This may be at most CDF_ATTR_NAME_LEN256 characters. Attribute names are case-sensitive.

CDFgetAttrNum may be used as an embedded function call when an attribute number is needed.

4.4.24.1. Example(s)

In the following example the attribute named pressure will be renamed to PRESSURE with CDFgetAttrNum being used as an embedded function call. Note that if the attribute pressure did not exist in the CDF, the call to CDFgetAttrNum would have returned an error code. Passing that error code to CDFattrRename as an attribute number would have resulted in CDFattrRename also returning an error code.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFrenameAttr (id, CDFgetAttrNum(id,"pressure"), "PRESSURE");
} catch (CDFException ex) {
    ...
}.

```

4.4.25 CDFgetAttrEntry²⁴

```

int CDFgetAttrEntry (          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int attrNum,                 /* in -- Attribute identifier. */
int entryNum,               /* in -- Entry number. */
TYPE value);                /* out -- Entry data. */
/* TYPE -- void*, "out string", "out string[]",
or "out object". */

```

This method is identical to the method CDFattrGet. CDFgetAttrEntry is used to read an rVariable attribute entry from a CDF. In most cases it will be necessary to call CDFinquireAttrEntry before calling CDFgetAttrEntry in order to determine the data type and number of elements (of that data type) for the entry.

The arguments to CDFgetAttrEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
----	---

²⁴ An array of strings may be returned, after CDF V3.7.0.

attrNum	Attribute number. This number may be determined with a call to CDFgetAttrNum.
entryNum	rVariable attribute entry number that is the rVariable number from which the attribute is read.
value	Entry value.

4.4.25.1. Example(s)

The following example displays the value of the UNITS attribute for the rEntry corresponding to the PRES_LVL rVariable (but only if the data type is CDF_CHAR).

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrN;          /* Attribute number. */
int  entryN;         /* Entry number. */
int  dataType;       /* Data type. */
int  numElems;      /* Number of elements (of data type). */
.
.
try {
    ....
    attrN = CDFattrNum (id, "UNITS");
    entryN = CDFvarNum (id, "PRES_LVL"); /* The rEntry number is the rVariable number. */
    status = CDFinquireAttrEntry (id, attrN, entryN, out dataType, out numElems);
    if (dataType == CDF_CHAR) {
        string buffer;
        status = CDFgetAttrEntry (id, attrN, entryN, out buffer);
    }
} catch (CDFException ex) {
    ...
}
.

```

4.4.26 CDFgetAttrEntryDataType

```

int CDFgetAttrEntryDataType (
void* id,
int attrNum,
int entryNum,
TYPE dataType);
/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- Attribute identifier. */
/* in -- rEntry number. */
/* out -- rEntry data type. */
/* TYPE -- int* or "out int". */

```

CDFgetAttrEntryDataType returns the data type of the rEntry from an (variable) attribute in a CDF. The data types are described in Section 2.6.

The arguments to `CDFgetAttrEntryDataType` are defined as follows:

`id` Identifier of the CDF. This identifier must have been initialized by a call to `CDFcreate` (or `CDFcreateCDF`) or `CDFopenCDF`.

`attrNum` Variable attribute number.

`entryNum` rEntry number.

`dataType` Data type of the rEntry.

4.4.26.1. Example(s)

The following example gets the data type for the entry of rVariable “MY_VARI” in the (variable) attribute “MY_ATTR” in a CDF.

```
.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  attrNum;         /* Attribute number. */
int  entryNum;        /* rEntry number. */
int  dataType;        /* rEntry data type. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    entryNum = CDFgetVarNum(id, "MY_VARI");
    status = CDFgetAttrEntryDataType (id, attrNum, entryNum, out dataType);
    Or
    status = CDFgetAttrEntryDataType (id, attrNum, entryNum, &dataType);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.27 CDFgetAttrEntryNumElements

```
int CDFgetAttrEntryNumElements (           /* out -- Completion status code. */
void* id,                                 /* in -- CDF identifier. */
int attrNum,                              /* in -- Attribute identifier. */
int varNum,                               /* in -- rVariable number. */
TYPE numElems);                          /* out -- rEntry's number of elements. */
                                           /* TYPE -- int* or "out int". */
```

`CDFgetAttrEntryNumElements` returns the number of elements of the rEntry from an (variable) attribute in a CDF.

The arguments to `CDFgetAttrEntryNumElements` are defined as follows:

`id` Identifier of the CDF. This identifier must have been initialized by a call to `CDFcreate` (or `CDFcreateCDF`) or `CDFopenCDF`.

`attrNum` Variable attribute number.

`varNum` rVariable number.

`numElems` Number of elements of the `rEntry`.

4.4.27.1. Example(s)

The following example gets the number of elements for the entry of rVariable “MY_VAR1” in the (variable) attribute “MY_ATTR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
int  varNum;         /* rVariable number. */
int  numElements;    /* rEntry's number of elements. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFgetAttrEntryNumElements (id, attrNum, varNum, out numElements);
    Or
    status = CDFgetAttrEntryNumElements (id, attrNum, varNum, &numElements);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.28 CDFgetAttrEntryNumStrings

```
int CDFgetAttrEntryNumStrings (
void* id,
int attrNum,
int varNum,
TYPE numStrings);
/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- Attribute identifier. */
/* in -- rVariable number. */
/* out -- rEntry's number of strings. */
/* TYPE -- int* or "out int". */
```

CDFgetAttrEntryNumStrings returns the number of strings of the rEntry from an (variable) attribute in a CDF. This method is relevant to string typed entry.

The arguments to CDFgetAttrEntryNumStrings are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum Variable attribute number.

varNum rVariable number.

numStrings Number of strings of the rEntry.

4.4.28.1. Example(s)

The following example gets the number of strings for the entry of rVariable “MY_VAR1” in the (variable) attribute “MY_ATTR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
int  varNum;         /* rVariable number. */
int  numStrings;     /* rEntry's number of strings. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFgetAttrEntryNumStrings (id, attrNum, varNum, out numStrings);
    Or
    status = CDFgetAttrEntryNumStrings (id, attrNum, varNum, &numStrings);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.29 CDFgetAttrEntryStrings

```
int CDFgetAttrEntryStrings (
void* id,
int attrNum,
int varNum,
TYPE strings);
/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- Attribute identifier. */
/* in -- rVariable number. */
/* out -- rEntry's data in strings. */
/* TYPE -- "out string[]" or "out object". */
```

CDFgetAttrEntryStrings returns the strings of the rEntry from an (variable) attribute in a CDF. This method is relevant to string typed entry.

The arguments to CDFgetAttrEntryStrings are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Variable attribute number.
varNum	rVariable number.
strings	The strings of the rEntry data.

4.4.29.1. Example(s)

The following example gets the strings for the entry of rVariable “MY_VAR1” in the (variable) attribute “MY_ATTR” in a CDF.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;         /* Attribute number. */
int  varNum;          /* rVariable number. */
string[] strings;     /* rEntry's returned strings. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFgetAttrEntryStrings (id, attrNum, varNum, out strings);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.30 CDFgetAttrScope

```
int CDFgetAttrScope (          /* out -- Completion status code. */
void* id,                    /* in -- CDF identifier. */
int attrNum,                 /* in -- Attribute number. */
TYPE attrScope);           /* out -- Attribute scope. */
                             /* TYPE -- int* or "out int". */
```



```

int attrNum,          /* in -- Attribute identifier. */
int varNum,          /* in -- zVariable number. */
TYPE numElems);    /* out -- zEntry's number of elements. */
                    /* TYPE -- int* or "out int". */

```

CDFgetAttrzEntryNumElements returns the number of elements of the zEntry for the specified variable attribute in a CDF.

The arguments to CDFgetAttrzEntryNumElements are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Variable attribute number.
varNum	zVariable number.
numElems	Number of elements of the zEntry.

4.4.33.1. Example(s)

The following example returns the number of elements for attribute named MY_ATTR for the zVariable MY_VAR1 in a CDF

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;        /* Attribute number. */
int  varNum;        /* zVariable number. */
int  numElements;    /* zEntry's number of elements. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFgetAttrzEntryNumElements (id, attrNum, varNum, out numElements);
    Or
    status = CDFgetAttrzEntryNumElements (id, attrNum, varNum, &numElements);

} catch (CDFException ex) {
    ...
}.
.

```

4.4.34 CDFgetAttrzEntryNumStrings


```

int CDFgetAttrzEntryNumStrings (
void* id,
int attrNum,
int varNum,
TYPE numStrings);

```

```

/* out -- Completion status code. */
/* in -- CDF identifier. */
/* in -- Attribute identifier. */
/* in -- zVariable number. */
/* out -- zEntry's number of strings. */
/* TYPE -- int* or "out int". */

```

CDFgetAttrzEntryNumStrings returns the number of strings of the zEntry from an (variable) attribute in a CDF. This method is relevant to string typed entry.

The arguments to CDFgetAttrzEntryNumStrings are defined as follows:

```

id          Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or
            CDFcreateCDF) or CDFopenCDF.

attrNum     Variable attribute number.

varNum      zVariable number.

numStrings  Number of strings of the zEntry.

```

4.4.34.1. Example(s)

The following example gets the number of strings for the entry of zVariable "MY_VARI" in the (variable) attribute "MY_ATTR" in a CDF.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  attrNum;         /* Attribute number. */
int  varNum;          /* zVariable number. */
int  numStrings;      /* zEntry's number of strings. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VARI");
    status = CDFgetAttrzEntryNumStrings (id, attrNum, varNum, out numStrings);
    Or
    status = CDFgetAttrzEntryNumStrings (id, attrNum, varNum, &numStrings);
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.35 CDFgetAttrzEntryStrings

```
int CDFgetAttrzEntryStrings (                                     /* out -- Completion status code. */
void* id,                                                         /* in -- CDF identifier. */
int attrNum,                                                      /* in -- Attribute identifier. */
int varNum,                                                       /* in -- zVariable number. */
TYPE strings);                                                  /* out -- zEntry's data in strings. */
                                                                /* TYPE -- "out string[]" or "out object". */
```

CDFgetAttrzEntryStrings returns the strings of the zEntry from an (variable) attribute in a CDF. This method is relevant to string typed entry.

The arguments to CDFgetAttrzEntryStrings are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Variable attribute number.
varNum	zVariable number.
strings	The strings of the zEntry data.

4.4.35.1. Example(s)

The following example gets the strings for the entry of zVariable "MY_VAR1" in the (variable) attribute "MY_ATTR" in a CDF.

```
.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  attrNum;         /* Attribute number. */
int  varNum;         /* zVariable number. */
string[] strings;     /* zEntry's returned strings. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum (id, "MY_ATTR");
    varNum = CDFgetVarNum(id, "MY_VAR1");
    status = CDFgetAttrzEntryStrings (id, attrNum, varNum, out strings);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.36 CDFgetNumAttrgEntries

```
int CDFgetNumAttrgEntries (                               /* out -- Completion status code. */
void* id,                                                /* in -- CDF identifier. */
int attrNum,                                           /* in -- Attribute number. */
TYPE entries);                                         /* out -- Total gEntries. */
                                                    /* TYPE -- int* or "out int". */
```

CDFgetNumAttrgEntries returns the total number of entries (gEntries) written for the specified global attribute in a CDF.

The arguments to CDFgetNumAttrgEntries are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number.
entries	Number of gEntries for attrNum.

4.4.36.1. Example(s)

The following example retrieves the total number of gEntries for the global attribute MY_ATTR in a CDF.

```
.
.
.
int status;                                           /* Returned status code. */
void* id;                                           /* CDF identifier. */
int attrNum;                                         /* Attribute number. */
int numEntries;                                     /* Number of entries. */
int i;
.
.
try {
    ....
    attrNum = CDFgetAttrNum(id, "MUY_ATTR");
    status = CDFgetNumAttrgEntries (id, attrNum, out numEntries);
    Or
    status = CDFgetNumAttrgEntries (id, attrNum, &numEntries);
    for (i=0; i < numEntries; i++) {
        .
        /* process an entry */
        .
    }
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.37 CDFgetNumAttributes

```
int CDFgetNumAttributes (                               /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
TYPE numAttrs);                                     /* out -- Total number of attributes. */
                                                    /* TYPE -- int* or "out int". */
```

CDFgetNumAttributes returns the total number of global and variable attributes in a CDF.

The arguments to CDFgetNumAttributes are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numAttrs	The total number of global and variable attributes.

4.4.37.1. Example(s)

The following example returns the total number of global and variable attributes in a CDF.

```
.
.
int status;                                           /* Returned status code. */
void* id;                                           /* CDF identifier. */
int numAttrs;                                       /* Number of attributes. */
.
.
try {
    ....
    status = CDFgetNumAttributes (id, out numAttrs);
    Or
    status = CDFgetNumAttributes (id, &numAttrs);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.38 CDFgetNumAttrrEntries

```
int CDFgetNumAttrrEntries (                           /* out -- Completion status code. */
void* id,                                             /* in -- CDF identifier. */
int attrNum,                                         /* in -- Attribute number. */
TYPE entries);                                       /* out -- Total rEntries. */
                                                    /* TYPE -- int* or "out int". */
```

CDFgetNumAttrEntries returns the total number of entries (rEntries) written for the rVariables in the specified (variable) attribute of a CDF.

The arguments to CDFgetNumAttrEntries are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number.
entries	Total rEntries.

4.4.38.1. Example(s)

The following example returns the total number of rEntries from the variable attribute “MY_ATTR” in a CDF.

```
.
.
.
int status;           /* Returned status code. */
void* id;             /* CDF identifier. */
int attrNum;         /* Attribute number. */
int entries;         /* Number of entries. */
.
.
try {
    ....
    attrNum = CDFgetAttrNum(id, "MY_ATTR");
    status = CDFgetNumAttrEntries (id, attrNum, out entries);
Or
    status = CDFgetNumAttrEntries (id, attrNum, &entries);
.
} catch (CDFException ex) {
    ...
}.
.
```

4.4.39 CDFgetNumAttrzEntries

```
int CDFgetNumAttrzEntries (           /* out -- Completion status code. */
void* id,                           /* in -- CDF identifier. */
int attrNum,                         /* in -- Attribute number. */
TYPE entries);                     /* out -- Total zEntries. */
                                     /* TYPE -- int* or "out int". */
```

CDFgetNumAttrzEntries returns the total number of entries (zEntries) written for the zVariables in the specified variable attribute in a CDF.

The arguments to CDFgetNumAttrzEntries are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number.
entries	Total zEntries.

4.4.39.1. Example(s)

The following example returns the total number of zEntries for the variable attribute MY_ATTR in a CDF.

```

.
.
.
int status; /* Returned status code. */
void* id; /* CDF identifier. */
int attrNum; /* Attribute number. */
int entries; /* Number of entries. */
.
.
try {
....
attrNum = CDFgetAttrNum(id, "MY_ATTR");
status = CDFgetNumAttrzEntries (id, attrNum, out entries);
Or
status = CDFgetNumAttrzEntries (id, attrNum, &entries);
.
} catch (CDFException ex) {
...
}.
.

```

4.4.40 CDFgetNumAttributes

```

int CDFgetNumAttributes ( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
TYPE numAttrs); /* out -- Total number of global attributes. */
/* TYPE -- int* or "out int". */

```

CDFgetNumAttributes returns the total number of global attributes in a CDF.

The arguments to CDFgetNumAttributes are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numAttrs	Number of global attributes.

4.4.40.1. Example(s)

The following example returns the total number of global attributes in a CDF.

```
.
.
.
int status; /* Returned status code. */
void* id; /* CDF identifier. */
int numAttrs; /* Number of global attributes. */

.
.
try {
    ....
    status = CDFgetNumAttributes (id, out numAttrs);
    Or
    . status = CDFgetNumAttributes (id, &numAttrs);
} catch (CDFException ex) {
    ...
}.
.
```

4.4.41 CDFgetNumvAttributes

```
int CDFgetNumvAttributes ( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
TYPE numAttrs); /* out -- Total number of variable attributes. */
/* TYPE -- int* or "out int". */
```

CDFgetNumvAttributes returns the total number of variable attributes in a CDF.

The arguments to CDFgetNumvAttributes are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
numAttrs	Number of variable attributes.

4.4.41.1. Example(s)

The following example returns the total number of variable attributes of a CDF.

```
.
```

```

.
.
int status; /* Returned status code. */
void* id; /* CDF identifier. */
int numAttrs; /* Number of variable attributes. */

.
.
try {
    ....
    status = CDFgetNumvAttributes (id, out numAttrs);
    Or
    status = CDFgetNumvAttributes (id, &numAttrs);
} catch (CDFException ex) {
    ...
}.
.

```

4.4.42 CDFinquireAttr

```

int CDFinquireAttr( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int attrNum, /* in -- Attribute number. */
out string attrName, /* out -- Attribute name. */
TYPE attrScope, /* out -- Attribute scope. */
TYPE maxgEntry, /* out -- Maximum gEntry number. */
TYPE maxrEntry, /* out -- Maximum rEntry number. */
TYPE maxzEntry); /* out -- Maximum zEntry number. */
/* TYPE -- int* or "out int". */

```

CDFinquireAttr is used to inquire information about the specified attribute. This method expands the method CDFattrInquire to provide an extra information about zEntry if the attribute has a variable scope.

The arguments to CDFinquireAttr are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number to inquire. This number may be determined with a call to CDFgetAttrNum.
attrName	Attribute's name that corresponds to attrNum. This string length is limited to CDF_ATTR_NAME_LEN256.
attrScope	The scope of the attribute (GLOBAL_SCOPE or VARIABLE_SCOPE). Attribute scopes are defined in Section 2.13.
maxgEntry	For vAttributes, this value of this field is -1 as it doesn't apply to global attribute entry (gEntry). For gAttributes, this is the maximum entry (gentry) number used. This number may not correspond with the number of entries (if some entry numbers were not used). If no entries exist for the attribute, then the value of -1 is returned.

maxrEntry	For gAttributes, this value of this field is -1 as it doesn't apply to rVariable attribute entry (rEntry). For vAttributes, this is the maximum rVariable attribute entry (rEntry) number used. This number may not correspond with the number of entries (if some entry numbers were not used). If no entries exist for the attribute, then the value of -1 is returned.
maxzEntry	For gAttributes, this value of this field is -1 as it doesn't apply to zVariable attribute entry (zEntry). For vAttributes, this is the maximum zVariable attribute entry (zEntry) number used. This may not correspond with the number of entries (if some entry numbers were not used). If no entries exist for the attribute, then the value of -1 is returned.

4.4.42.1. Example(s)

The following example displays the name of each attribute in a CDF. The number of attributes in the CDF is first determined by calling the method CDFInquireCDF. Note that attribute numbers start at zero (0) and are consecutive.

```

.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numDims;        /* Number of dimensions. */
int[] dimSizes;      /* Dimension sizes (allocate to allow the
                    /* maximum number of dimensions). */

int  encoding;       /* Data encoding. */
int  majority;      /* Variable majority. */
int  maxRec;        /* Maximum record number in CDF. */
int  numVars;       /* Number of variables in CDF. */
int  numAttrs;     /* Number of attributes in CDF. */
int  attrN;        /* attribute number. */
string attrName;   /* attribute name. */
int  attrScope;   /* attribute scope. */
int  maxgEntry, maxrEntry, maxzEntry; /* Maximum entry numbers. */

.
.
try {
    ....
    status = CDFInquireCDF (id, out numDims, out dimSizes, out encoding, out majority, out maxRec,
                          out numVars, out numAttrs);
    for (attrN = 0; attrN < (int)numAttrs; attrN++) {
        status = CDFInquireAttr (id, attrN, out attrName, out attrScope, out maxgEntry, out maxrEntry,
                                out maxzEntry);

        Or
        status = CDFInquireAttr (id, attrN, out attrName, &attrScope, &maxgEntry, &maxrEntry, &maxzEntry);
    }
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.43 CDFinquireAttrgEntry

```
int CDFinquireAttrgEntry (                                /* out -- Completion status code. */
void* id,                                                /* in -- CDF identifier. */
int attrNum,                                           /* in -- attribute number. */
int entryNum,                                          /* in -- Entry number. */
TYPE dataType,                                         /* out -- Data type. */
TYPE numElements);                                     /* out -- Number of elements (of the data type). */
                                                    /* TYPE -- int* or "out int". */
```

This method is identical to CDFattrEntryInquire. CDFinquireAttrgEntry is used to inquire information about a global attribute entry.

The arguments to CDFinquireAttrgEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number to inquire. This number may be determined with a call to CDFgetAttrNum.
entryNum	Entry number to inquire.
dataType	Data type of the specified entry. The data types are defined in Section 2.6.
numElements	Number of elements of the data type. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string. For all other data types this is the number of elements in an array of that data type.

4.4.43.1. Example(s)

The following example returns each entry for a global attribute named TITLE. Note that entry numbers need not be consecutive - not every entry number between zero (0) and the maximum entry number must exist. For this reason NO_SUCH_ENTRY is an expected error code.

```
.
.
.
void*      id;                                           /* CDF identifier. */
Int  status;                                           /* Returned status code. */
int  attrN;                                           /* attribute number. */
int  entryN;                                          /* Entry number. */
string attrName;                                       /* attribute name. */
int  attrScope;                                       /* attribute scope. */
int  maxEntry;                                        /* Maximum entry number used. */
int  dataType;                                        /* Data type. */
int  numElem;                                        /* Number of elements (of the data type). */
.
.
try {
    ....
    attrN = CDFgetAttrNum (id, "TITLE");
    status = CDFattrInquire (id, attrN, attrName, out attrScope, out maxEntry);
```

```

for (entryN = 0; entryN <= maxEntry; entryN++) {
    status = CDFinquireAttrEntry (id, attrN, entryN, out dataType, out numElems);
    Or
    status = CDFinquireAttrEntry (id, attrN, entryN, &dataType, &numElems);
    /* process entries */
    .
    .
}
} catch (CDFException ex) {
    ...
}.

```

4.4.44 CDFinquireAttrEntry

```

int CDFinquireAttrEntry (                                     /* out -- Completion status code. */
void* id,                                                  /* in -- CDF identifier. */
int attrNum,                                              /* in -- Attribute number. */
int entryNum,                                           /* in -- Entry number. */
TYPE dataType,                                          /* out -- Data type. */
TYPE numElements);                                     /* out -- Number of elements (of the data type). */
/* TYPE -- int* or "out int". */

```

This method is identical to the method CDFattrEntryInquire. CDFinquireAttrEntry is used to inquire about an rVariable's attribute entry.

The arguments to CDFinquireAttrEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number to inquire. This number may be determined with a call to CDFgetAttrNum.
entryNum	Entry number to inquire. This is the rVariable number (the rVariable being described in some way by the rEntry).
dataType	Data type of the specified entry. The data types are defined in Section 2.6.
numElements	Number of elements of the data type. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string. For all other data types this is the number of elements in an array of that data type.

4.4.44.1. Example(s)

The following example determines the data type of the "UNITS" attribute for the rVariable "Temperature", then retrieves and displays the value of the UNITS attribute.

```

.
.

```



```

int numElements,          /* in -- Number of elements in the entry (of the data type). */
TYPE value);           /* in -- Attribute entry value. */
                        /* TYPE -- void*, string or object. */

```

CDFputAttrEntry is used to write a global attribute entry. The entry may or may not already exist. If it does exist, it is overwritten. The data type and number of elements (of that data type) may be changed when overwriting an existing entry. A global attribute can have one or more attribute entries.

The arguments to CDFputAttrEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number. This number may be determined with a call to CDFgetAttrNum.
entryNum	Attribute entry number.
dataType	Data type of the specified entry. Specify one of the data types defined in Section 2.6.
numElements	Number of elements of the data type. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string (An array of characters). For all other data types this is the number of elements in an array of that data type.
value	Value(s) to write. The entry value is written to the CDF from memory address value.

4.4.46.1. Example(s)

The following example writes a global attribute entry to the global attribute called TITLE.

```

.
.
.
void*      id;           /* CDF identifier. */
int  status;           /* Returned status code. */
int  entryNum;        /* Attribute entry number. */
string  title = "CDF title."; /* Value of TITLE attribute. */

.
.
entryNum = 0;
try {
    ....
    status = CDFputAttrEntry (id, CDFgetAttrNum(id,"TITLE"), entryNum, CDF_CHAR, title.Length, title);
} catch (CDFException ex) {
    ...
}.
.

```



```

int varNum; /* Entry number. */
string[] TMPvalids = new string[] {"abc", "1234"}; /* Value(s) of VALIDs attribute,
                                                    rEntry for rVariable TMP. */

.
try {
    ....
    status = CDFputAttrEntryStrings (id, CDFgetAttrNum(id,"VALIDs"), CDFgetVarNum(id,"TMP"),
                                    TMPvalids);

.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.49 CDFputAttrzEntry

```

int CDFputAttrzEntry( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int attrNum, /* in -- Attribute number. */
int entryNum, /* in -- Attribute entry number. */
string value); /* in -- Attribute entry value in string. */

int CDFputAttrzEntry( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int attrNum, /* in -- Attribute number. */
int entryNum, /* in -- Attribute entry number. */
int dataType, /* in -- Data type of this entry. */
int numElements, /* in -- Number of elements in the entry (of the data type). */
TYPE value); /* in -- Attribute entry value. */
/* TYPE -- void*, string or object. */

```

CDFputAttrzEntry is used to write zVariable's attribute entry. The entry may or may not already exist. If it does exist, it is overwritten. The data type and number of elements (of that data type) may be changed when overwriting an existing entry.

The arguments to CDFputAttrzEntry are defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	The (variable) attribute number. This number may be determined with a call to CDFgetAttrNum (see Section 4.4.24).
entryNum	Entry number that is the zVariable number to which this attribute entry belongs.
dataType	Data type of the specified entry. Specify one of the data types defined in Section 2.6.
numElements	Number of elements of the data type. For character data types (CDF_CHAR and CDF_UCHAR), this is the number of characters in the string (An array of characters). For all other data types this is the number of elements in an array of that data type.

value Value(s) to write. The entry value is written to the CDF from memory address value.

4.4.49.1. Example(s)

The following example writes a zVariable's attribute entry. The entry has two elements (that is two values for non-CDF_CHAR type). The zEntry in the variable scope attribute VALIDs corresponds to the zVariable TMP.

```
.
.
.
void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
int  numElements;    /* Number of elements (of data type). */
short[]    TMPvalids = new short[] {15,30}; /* Value(s) of VALIDs attribute,
                                           zEntry for zVariable TMP. */
.
.
numElements = 2;
try {
    ....
    status = CDFputAttrzEntry (id, CDFgetAttrNum(id,"VALIDs"), CDFgetVarNum(id,"TMP"),
                              CDF_INT2, numElements, TMPvalids);
Or
    fixed (void* pTMPvalids = TMPvalids) {
        status = CDFputAttrzEntry (id, CDFgetAttrNum(id,"VALIDs"), CDFgetVarNum(id,"TMP"),
                                   CDF_INT2, numElements, pTMPvalids);
    }
} catch (CDFException ex) {
    ...
}.
.
```

4.4.50 CDFputAttrzEntryStrings

```
int CDFputAttrzEntryStrings( /* out -- Completion status code. */
void* id, /* in -- CDF identifier. */
int attrNum, /* in -- Attribute number. */
int varNum, /* in -- zVariable number. */
TYPE value); /* in -- Attribute entry value. */
/* TYPE -- string[] or object. */
```

CDFputAttrzEntryStrings is used to write zVariable's attribute entry, which is an array of strings. The entry may or may not already exist. If it does exist, it is overwritten.

The arguments to CDFputAttrzEntryStrings are defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.

attrNum	Attribute number. This number may be determined with a call to CDFgetAttrNum.
varNum	Attribute entry number that is the zVariable number to which this attribute entry belongs.
value	Value(s) to write. The entry value is written to the CDF from memory address value.

4.4.50.1. Example(s)

The following example writes to the variable scope attribute VALIDs for the entry, of two strings, that corresponds to the zVariable TMP.

```

.
.
.
void*      id;                /* CDF identifier. */
int  status;                  /* Returned status code. */
int  varNum;                 /* Entry number. */
string[]  TMPvalids = new string[] {"abc", "1234"}; /* Value(s) of VALIDs attribute,
                                                    zEntry for rVariable TMP. */
.
try {
    ....
    status = CDFputAttrzEntryStrings (id, CDFgetAttrNum(id,"VALIDs"), CDFgetVarNum(id,"TMP"),
                                      TMPvalids);
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.51 CDFrenameAttr

```

int CDFrenameAttr(           /* out -- Completion status code. */
void* id,                   /* in -- CDF identifier. */
int attrNum,                /* in -- Attribute number. */
string attrName);          /* in -- New attribute name. */

```

This method is identical to method CDFattrRename. CDFrenameAttr renames an existing attribute.

4.4.51.1. Example(s)

In the following example the attribute named LAT is renamed to LATITUDE.

```

.
.
.

```

```

void*      id;          /* CDF identifier. */
int  status;          /* Returned status code. */
.
.
try {
    ....
    status = CDFrenameAttr (id, CDFgetAttrNum(id,"LAT"), "LATITUDE");
.
} catch (CDFException ex) {
    ...
}.
.

```

4.4.52 CDFsetAttrgEntryDataSpec

```

int CDFsetAttrgEntryDataSpec (          /* out -- Completion status code. */
void* id,                               /* in -- CDF identifier. */
int attrNum,                            /* in -- Attribute number. */
int entryNum,                           /* in -- gEntry number. */
int dataType)                           /* in -- Data type. */

```

CDFsetAttrgEntryDataSpec respecifies the data type of a gEntry of a global attribute in a CDF. The new and old data type must be equivalent. Refer to the CDF User's Guide for descriptions of equivalent data types.

The arguments to CDFsetAttrgEntryDataSpec are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Global attribute number.
entryNum	gEntry number.
dataType	New data type.

4.4.52.1. Example(s)

The following example modifies the third entry's (entry number 2) data type of the global attribute MY_ATTR in a CDF. It will change its original data type from CDF_INT2 to CDF_UINT2.

```

.
.
.
void* id;          /* CDF identifier. */
int  status;      /* Returned status code. */
int  entryNum;    /* gEntry number. */
int  dataType;    /* The new data type */
.
.
entryNum = 2;

```

```

dataType = CDF_UINT2;
numElems = 1;
try {
    ....
    status = CDFsetAttrEntryDataSpec (id, CDFgetAttrNum(id, "MY_ATTR"), entryNum, dataType);
} catch (CDFException ex) {
    ....
}.
.

```

4.4.53 CDFsetAttrEntryDataSpec

```

int CDFsetAttrEntryDataSpec (                                     /* out -- Completion status code. */
void* id,                                                       /* in -- CDF identifier. */
int attrNum,                                                   /* in -- Attribute number. */
int entryNum,                                                  /* in -- rEntry number. */
int dataType,                                                  /* in -- Data type. */
int numElements);                                             /* in -- Number of elements. */

```

CDFsetAttrEntryDataSpec respecifies the data specification (data type and number of elements) of an rEntry of a variable attribute in a CDF. The new and old data type must be equivalent, and the number of elements must not be changed. Refer to the CDF User's Guide for descriptions of equivalent data types.

The arguments to CDFsetAttrEntryDataSpec are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Variable attribute number.
entryNum	rEntry number.
dataType	New data type.
numElements	New number of elements.

4.4.53.1. Example(s)

The following example modifies the data specification for an rEntry, corresponding to rVariable "MY_VAR", in the variable attribute "MY_ATTR" in a CDF. It will change its original data type from CDF_INT2 to CDF_UINT2.

```

.
.
.
void* id;                                                       /* CDF identifier. */
int status;                                                    /* Returned status code. */
int dataType, numElements;                                     /* Data type and number of elements. */
.
.

```

```

dataType = CDF_UINT2;
numElems = 1;
try {
    ....
    status = CDFsetAttrEntryDataSpec (id, CDFgetAttrNum(id, "MY_ATTR"), CDFgetVarNum(id, "MY_VAR"),
                                      dataType, numElems);
    .
} catch (CDFException ex) {
    ....
}.
.

```

4.4.54 CDFsetAttrScope

```

int CDFsetAttrScope (                                     /* out -- Completion status code. */
void* id,                                               /* in -- CDF identifier. */
int attrNum,                                           /* in -- Attribute number. */
int scope);                                           /* in -- Attribute scope. */

```

CDFsetAttrScope respecifies the scope of an attribute in a CDF. Specify one of the scopes described in Section 2.13. Global-scoped attributes will contain only gEntries, while variable-scoped attributes can hold rEntries and zEntries.

The arguments to CDFsetAttrScope are defined as follows:

id	Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
attrNum	Attribute number.
scope	New attribute scope. The value should be either VARIABLE_SCOPE or GLOBAL_SCOPE.

4.4.54.1. Example(s)

The following example changes the scope of the global attribute named MY_ATTR to a variable attribute (VARIABLE_SCOPE).

```

.
.
.
void* id;                                               /* CDF identifier. */
int status;                                           /* Returned status code. */
int scope;                                           /* New attribute scope. */
.
.
scope = VARIABLE_SCOPE;
try {
    ....
    status = CDFsetAttrScope (id, CDFgetAttrNum(id, "MY_ATTR"), scope);
    .
} catch (CDFException ex) {

```

```

...
}.
.

```

4.4.55 CDFsetAttrzEntryDataSpec

```

int CDFsetAttrzEntryDataSpec (                               /* out -- Completion status code. */
void* id,                                                    /* in -- CDF identifier. */
int attrNum,                                                /* in -- Attribute number. */
int entryNum,                                              /* in -- zEntry number. */
int dataType)                                              /* in -- Data type. */

```

CDFsetAttrzEntryDataSpec modifies the data type of a zEntry of a variable attribute in a CDF. The new and old data type must be equivalent. Refer to the CDF User’s Guide for the description of equivalent data types.

The arguments to CDFsetAttrzEntryDataSpec are defined as follows:

- id Identifier of the current CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopenCDF.
- attrNum Variable attribute number.
- entryNum zEntry number that is the zVariable number.
- dataType Data type.

4.4.55.1. Example(s)

The following example respecifies the data type of the attribute entry of the attribute named MY_ATTR that is associated with the zVariable MY_VAR. It will change its original data type from CDF_INT2 to CDF_UINT2.

```

.
.
.
void* id;                                                    /* CDF identifier. */
int status;                                                 /* Returned status code. */
int dataType;                                              /* Data type and number of elements. */
.
.
try {
....
dataType = CDF_UINT2;
numElems = 1;
status = CDFsetAttrzEntryDataSpec (id, CDFgetAttrNum(id, "MY_ATTR"),
                                   CDFgetVarNum(id, "MY_VAR"), dataType);
.
} catch (CDFException ex) {
....
}.

```

4.5 Read Functions

This section provides a set of easy-to-use read functions that each will return an object of C#'s **Dictionary**, a set of key/value pairs. The key is either a string or an integer. The value can be a generic scalar or array of value of integer, floating value, or string, or another dictionary (of dictionaries). The returned information covers CDF basic information, global attributes, and variables' specification, metadata and data. Each functions is made of calls from other lower-level functions.

4.5.1 ReadCDF

```
Dictionary<string,object> ReadCDF (
void* id); /* out – A dictionary . */
/* in -- CDF identifier. */

Dictionary(string,object> ReadCDF (
void* id, /* out – A dictionary . */
bool encoding); /* in -- CDF identifier. */
/* in -- Whether to encode CDF epoch type */

Dictionary<string,object> ReadCDF (
void* id, /* out – A dictionary . */
bool encoding, /* in -- CDF identifier. */
bool basic, /* in -- Whether to encode CDF epoch type */
bool global, /* in -- Whether to get CDF basic information */
bool var); /* in -- Whether to get global metadata */
/* in -- Whether to get all variables' information */

Dictionary<string,object> ReadCDF (
void* id, /* out – A dictionary . */
bool encoding, /* in -- CDF identifier. */
bool basic, /* in -- Whether to encode CDF epoch type */
bool global, /* in -- Whether to get CDF basic information */
bool varspec, /* in -- Whether to get global metadata */
bool varmeta, /* in -- Whether to get each variable's specification */
bool vardata); /* in -- Whether to get each variable's metadata */
/* in -- Whether to get each variable's data */

Dictionary<string,object> ReadCDF (
void* id, /* out – A dictionary . */
bool encoding, /* in -- CDF identifier. */
bool basic, /* in -- Whether to encode CDF epoch type */
bool global, /* in -- Whether to get CDF basic information */
bool varspec, /* in -- Whether to get global metadata */
bool varmeta, /* in -- Whether to get each variable's specification */
bool vardata, /* in -- Whether to get each variable's metadata */
bool noentry); /* in -- Whether to get each variable's data */
/* in -- Whether to show attributes without entry */
```

ReadCDF reads the specific element or all CDF information. There are three main key/value elements in the top of retrieved dictionary. The keys are “CDFInfo”, “GlobalAttributes” and “Variables”. Each of the values is also a dictionary itself. There may be another key/value element: “NoEntryAttributes” in the top dictionary.

The argument to ReadCDF is defined as follows:

id Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.

Optionally,

encoding	Whether to encode any CDF epoch data type in global or variable metadata into date/time string.
basic	Whether to read the CDF basic information.
global	Whether to read the global attributes.
var	Whether to read information from all variables.
varspec	Whether to read each variable's specification.
varmeta	Whether to read each variable's metadata.
vardata	Whether to read variable's data
noentry	Whether to collect the attribute names that don't have any entry data

4.5.1.1. Example(s)

The following example reads the whole information from the CDF, test.cdf and displays it.

```

.
.
.
void*      id;           /* CDF identifier. */
int        status;      /* Returned status code. */
Dictionary<string, object> cdf; /* Retrieved information. */
.
.
try {
...
status = CDFopen ("test", &id);
cdf = ReadCDFInfo (id);
CDFUtils.PrintDictionary (cdf);
...
...
} catch (CDFException ex) {
...
}
.
.

```

The output of the dictionary dump from the CDF looks as follows. The four keys are CDFInfo, GlobalAttributes, Variables and NoEntryAttributes. The value for CDFInfo is a dictionary, which contains the basic information about the CDF. The value for GlobalAttributes is a dictionary of dictionaries. Each element in the dictionary has the attribute name as the key with its value being another dictionary (with entry number being the key and value being the entry). The value for Variables is a dictionary of dictionaries. Each element in the dictionary is for information from a variable. The variable name is then the key for its specification, metadata and data, each of which is also a dictionary. If there is any attribute(s), global or variable, that has no entry data, its name will be collected in a list as a "GlobalAttributes" or "VariableAttributes" key element in the "NoEntryAttributes" dictionary.

```

CDFInfo =>
Version => "3.7.0"
Majority => "ROW"
Format => "SINGLE"
Encoding => "IBMPC"

```

```
...
...
GlobalAttributes =>
  Project
    0 => "..."
  PI =>
    0 => "Mr.Smith"
  Text =>
    0 => "Line 1"
    1 => "Line 2"
  ...
  ...
Key:Variables =>
  Var1 =>
    VarInfo
      DataType => "CDF_INT2"
      NumElements => 1
      NumDims => 1
      ...
      ...
      ...
    Key:VarMetaData =>
      VALIDMIN => 20
      VALIDMAX => 90
      ...
      ...
    VarData => 1 2 3
  Var2 =>
    VarInfo =>
      DataType => "CDF_INT4"
      NumElements => 1
      NumDims => 0
      ...
      ...
      ...
    VarMetaData =>
      VALIDMIN => 2000
      VALIDMAX => 9000
      ...
      ...
    VarData => 1
                2
                3
  Var3 =>
    VarInfo =>
      DataType => "CDF_DOUBLE"
      NumElements => 1
      NumDims => 1
      ...
      ...
      ...
    VarMetaData =>
      VALIDMIN => 20.0
      VALIDMAX => 90.0
      ...
      ...
```

```

VarData => 1.1 2.2 3.3
...
...
NoEntryAttributes =>
GlobalAttributes => "g1"
VariableAttributes => "a1"

```

4.5.2 ReadCDFGlobalAttributes

```

Dictionary<string,object> ReadCDFGlobalAttributes (          /* out – A dictionary . */
void* id);                                                /* in -- CDF identifier. */

Dictionary(string,object> ReadCDFGlobalAttributes (        /* out – A dictionary . */
void* id,                                                 /* in -- CDF identifier. */
bool encoding);                                          /* in -- Whether to encode CDF epoch type */

```

ReadCDFGlobalAttributes reads the global attributes for a given CDF. The value(s) in the key/value pair(s) from the returned dictionary can be a dictionary itself.

The argument to ReadCDFGlobalAttributes is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
Optionally,	
encoding	Whether to encode any CDF epoch data type in global or variable metadata.

4.5.2.1. Example(s)

The following example reads the global attributes from the CDF, test.cdf and displays it.

```

.
.
.
void*      id;          /* CDF identifier. */
int        status;     /* Returned status code. */
Dictionary<string, object> meta; /* Retrieved information. */
.
.
try {
...
status = CDFopen ("test", &id);
meta = ReadCDFGlobalAttributes (id);
CDFUtils.PrintDictionary (meta);
...
...
} catch (CDFException ex) {
...
}
.
.

```

The output of the dictionary dump from the global attributes in the CDF looks as follows. Each key field represents a global attribute name, and its value, which is another dictionary of <integer, object> type pair(s). The number represents the entry number and the object can be a scalar or array of an entry type.

```
Project =>
  0 => "Using the CDFJava API "
PI
  3 => "Ernie Els"
Test =>
  0 => 5.3432
  2 => 5.5
  3 => 5.5 10.2
  4 => 1
  5 => 1 2 3
  6 => -32768
  7 => 1 2
  8 => 3
  9 => 4 5
  10 => "This is a string"
  11 => 4294967295
  12 => 4294967295 2147483648
  13 => 65535
  14 => 65535 65534
  15 => 255
  16 => 255 254
TestDate =>
  1 => "2002-04-25T00:00:00.000"
  2 => "2008-02-04T06:08:10.012014016"
epTestDate =>
  0 => "2004-05-13T15:08:11.022033044055"
```

4.5.3 ReadCDFInfo

```
Dictionary<string,object> ReadCDFInfo (          /* out -- A dictionary . */
void* id)                                       /* in -- CDF identifier. */
```

ReadCDFInfo reads the basic information about a CDF.

The argument to ReadCDFInfo is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
----	--

4.5.3.1. Example(s)

The following example reads the whole information from the CDF, test.cdf and displays it.

```
.
.
.
void*    id;          /* CDF identifier. */
int      status;     /* Returned status code. */
```

```

Dictionary<string, object>    cdf;                               /* Retrieved information. */
.
.
try {
    ...
    status = CDFopen ("test", &id);
    cdf = ReadCDFInfo (id);
    CDFUtils.PrintDictionary (cdf);
    ...
    ...
} catch (CDFException ex) {
    ...
}
.
.

```

The output of the basic CDF information looks as follows (first field as the key and second field as the value):

```

Version => "3.7.0"
Majority => "ROW"
Format => "SINGLE"
Encoding => "IBMPC"
NumGlobalAttrs => 5
NumNumVarAttrs => 5
NumVars => 21
LastLeapSecond => 20150701

```

4.5.4 ReadCDFVariable

```

Dictionary<string,object> ReadCDFVariable(                       /* out – A dictionary . */
void* id,                                                         /* in -- CDF identifier. */
int varid);                                                       /* in -- variable identifier. */

Dictionary<string,object> ReadCDFVariable(                       /* out – A dictionary . */
void* id,                                                         /* in -- CDF identifier. */
int varid,                                                        /* in -- variable identifier. */
bool encoding);                                                  /* in -- Whether to encode CDF epoch type. */

```

ReadCDFVariable reads the information from a specified variable in a CDF into a dictionary. The variable information includes the variable specification with key: “VarInfo”, its metadata with key: “VarMetaData” and all data with key: “VarData”, if they exist. The retrieved information consists of the information from these three functions: ReadCDFVariableInfo, ReadCDFVariableAttributes and ReadCDFVariableData.

The argument to ReadCDFVariable is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varid	Variable identifier in the CDF. This identifier is based on the CDF open with zMODEon2 (all variables are being handled as zVariables) if there are rVariables and zVariables in a CDF. The variable identifier reflects the variable after renumbered.

Optionally,

encoding Whether to encode the CDF epoch data type into date/time string.

4.5.4.1. Example(s)

The following example collects the information from a variable 'Var1' in the CDF, test.cdf and displays it.

```
.
.
.
void*      id;           /* CDF identifier. */
int        status;      /* Returned status code. */
int        varid;       /* Variable identifier. */
Dictionary<string, object> var; /* Retrieved information. */
.
.
try {
...
status = CDFopen ("test", &id);
status = CDFsetzMode (id, zMODEon2);
varid = CDFgetVarNum (id, "Var1");
var = ReadCDFVariable (id, varid);
...
...
} catch (CDFException ex) {
...
}
.
.
```

The output of the variable dictionary dump looks as follows. Basically, there are three key/value pairs at the top level for variable's specification, metadata and data, identified by the Key name. For specification and metadata, its value is another dictionary.

```
VarInfo =>
  DataType => "CDF_INT2"
  NumElements => 1
  NumDims => 1
  DimSizes => 3
  NumWrittenRecs => 20
  PadValue => -32767
VarMetaData =>
  VALIDMIN => -100
  VALIDMAX => 180
  FILLVAL => -999
...
...
VarData => 100 200 300
           -32767 -32767 -32767
           10 20 30
           40 32767 -32768
           -32767 -32767 -32767
```

```

-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767
11 22 33
-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767
-32767 -32767 -32767

```

4.5.5 ReadCDFVariables

```

Dictionary<string,object> ReadCDFVariables(          /* out – A dictionary . */
void* id);                                         /* in -- CDF identifier. */

Dictionary<string,object> ReadCDFVariables(        /* out – A dictionary . */
void* id,                                         /* in -- CDF identifier. */
bool encoding);                                  /* in -- Whether to encode CDF epoch type. */

```

ReadCDFVariables reads the information from all variables in a CDF into a dictionary. Each element in the dictionary has the variable name as the key and its information as the value, which is a dictionary itself. The variable information includes the variable specification (with key: “VarInfo”), its metadata (with key: “VarMetaData”) and all data (with key: “VarData”), if they exist.

The argument to ReadCDFVariables is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
----	--

Optionally,

encoding	Whether to encode the CDF epoch data type into date/time string for metadata.
----------	---

4.5.5.1. Example(s)

The following example collects the information from a variable ‘Var1’ in the CDF, test.cdf and displays it.

```

.
.
.
void*      id;          /* CDF identifier. */
int        status;     /* Returned status code. */
int        varid;      /* Variable identifier. */
Dictionary<string, object> cdf; /* Retrieved information. */
.
.
try {
...
status = CDFopen (“test”, &id);
cdf = ReadCDFVariables (id);
...
}

```

```

    CDFUtils.PrintDictionary (cdf);
} catch (CDFException ex) {
    ...
}
.
.

```

The output of the variable dictionary dump looks as follows. Basically, there are three key/value pairs at the top level for variable's specification, metadata and data, identified by the Key name. For specification and metadata, its value is another dictionary.

```

Var1 =>
  VarInfo =>
    DataType => "CDF_INT1"
    NumElements => 1
    NumDims => 1
    DimSizes => 3
    NumWrittenRecs => 1
    PadValue => -127
  VarMetaData =>
    VALIDMIN => 20
    VALIDMAX => 90
  VarData => 1 2 3
Var2 =>
  VarInfo =>
    DataType => "CDF_UINT1"
    NumElements => 1
    NumDims => 1
    DimSizes => 3
    NumWrittenRecs => 3
    PadValue => 254
  VarData => 254 254 5
           15 25 35
           100 128 255
Var3 =>
  VarInfo =>
    DataType => "CDF_INT2"
    NumElements => 1
    NumDims => 1
    DimSizes => 3
    NumWrittenRecs => 20
    PadValue => -32767
  VarMetaData =>
    VALIDMIN => -100
    VALIDMAX => 180
    ...
    ...
  VarData => 100 200 300
           -32767 -32767 -32767
           10 20 30
           40 32767 -32768
           -32767 -32767 -32767
           -32767 -32767 -32767
           -32767 -32767 -32767
           -32767 -32767 -32767
           -32767 -32767 -32767

```


4.5.6 ReadCDFVariableAttributes

```
Dictionary<string,object> ReadCDFVariableAttributes(  
void* id,  
int varid);
```

```
/* out – A dictionary . */  
/* in -- CDF identifier. */  
/* in -- variable identifier. */
```

```
Dictionary<string,object> ReadCDFVariableAttributes(  
void* id,  
int varid,  
bool encoding);
```

```
/* out – A dictionary . */  
/* in -- CDF identifier. */  
/* in -- variable identifier. */  
/* in -- Whether to encode CDF epoch type. */
```

ReadCDFVariableAttributes reads the specified variable's metadata in a CDF into a dictionary. The key for the key/value pair(s) in the dictionary is the variable attribute name.

The argument to ReadCDFVariableAttributes is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varid	Variable identifier in the CDF. This identifier is based on the CDF open with zMODEon2 (all variables are being handled as zVariables) if there are rVariables and zVariables in a CDF. The variable identifier reflects the variable after renumbered.

Optionally,

encoding	Whether to encode the CDF epoch data type into date/time string.
----------	--

4.5.6.1. Example(s)

The following example collects the metadata from a variable 'Var1' in the CDF, test.cdf and displays it.

```
.  
. .  
void*      id;          /* CDF identifier. */  
int        status;     /* Returned status code. */  
int        varid;      /* Variable identifier. */  
Dictionary<string, object> attrs; /* Retrieved information. */  
. .  
try {  
    ...  
    status = CDFopen ("test", &id);  
    status = CDFsetzMode (id, zMODEon2);  
    varid = CDFgetVarNum (id, "Var1");  
    attrs = ReadCDFVariableAttributes (id, varid);  
    CDFUtils.PrintDictionary (attrs);  
    ...  
    ...  
} catch (CDFException ex) {
```

```
...
}
.
.
```

The output of the variable attributes dictionary dump looks as follows (the key is variable attribute name):

```
VALIDMIN => -100
VALIDMAX => 180
FILLVAL => -999
...
...
```

4.5.7 ReadCDFVariableData

```
object ReadCDFVariableData(          /* out – A dictionary . */
void* id,                          /* in -- CDF identifier. */
int varid);                         /* in -- variable identifier. */
```

ReadCDFVariableData reads the specified variable's data in a CDF into an object.

The argument to ReadCDFVariableData is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varid	Variable identifier in the CDF. This identifier is based on the CDF open with zMODEon2 (all variables are being handled as zVariables) if there are rVariables and zVariables in a CDF. The variable identifier reflects the variable after renumbered.

4.5.7.1. Example(s)

The following example reads the full data from a variable 'Var1' in the CDF, test.cdf.

```
void*      id;          /* CDF identifier. */
int        status;     /* Returned status code. */
int        varid;      /* Variable identifier. */
object     data;       /* Retrieved data. */
.
.
try {
...
status = CDFopen ("test", &id);
status = CDFsetzMode (id, zMODEon2);
varid = CDFgetVarNum (id, "Var1");
data = ReadCDFVariableData (id, varid);
...
...
} catch (CDFException ex) {
...
}
.
.
```

4.5.8 ReadCDFVariableInfo

```
Dictionary<string,object> ReadCDFVariableInfo(  
void* id,  
int varid);
```

```
/* out – A dictionary . */  
/* in -- CDF identifier. */  
/* in -- variable identifier. */
```

```
Dictionary<string,object> ReadCDFVariableInfo(  
void* id,  
int varid,  
bool encoding);
```

```
/* out – A dictionary . */  
/* in -- CDF identifier. */  
/* in -- variable identifier. */  
/* in -- Whether to encode CDF epoch type. */
```

ReadCDFVariableInfo reads the specified variable's specification in a CDF into a dictionary.

The argument to ReadCDFVariableInfo is defined as follows:

id	Identifier of the CDF. This identifier must have been initialized by a call to CDFcreate (or CDFcreateCDF) or CDFopen.
varid	Variable identifier in the CDF. This identifier is based on the CDF open with zMODEon2 (all variables are being handled as zVariables) if there are rVariables and zVariables in a CDF. The variable identifier reflects the variable after renumbered.

Optionally,

encoding	Whether to encode the CDF epoch data type into date/time string.
----------	--

4.5.8.1. Example(s)

The following example collects the basic information from a variable 'Var1' in the CDF, test.cdf and displays it.

```
.  
. .  
void*      id;          /* CDF identifier. */  
int        status;     /* Returned status code. */  
int        varid;      /* Variable identifier. */  
Dictionary<string, object> info; /* Retrieved information. */  
. .  
try {  
    ...  
    status = CDFopen ("test", &id);  
    status = CDFsetzMode (id, zMODEon2);  
    varid = CDFgetVarNum (id, "Var1");  
    info = ReadCDFVariableInfo (id, varid);  
    CDFUtils.PrintDictionary (info);  
    ...  
    ...  
} catch (CDFException ex) {
```

```
...  
}  
.  
.
```

The output of the dictionary dump for the specification of the variable looks as follows (first field as the key and second field as the value):

```
DataType => "CDF_INT2"  
NumElements => 1  
NumDims => 1  
DimSizes => 3  
NumWrittenRecs => 20  
PadValue => -32767
```


Chapter 5

5 Interpreting CDF Status Codes

Most CDF APIs return a status code of type `int`. The symbolic names for these codes are defined in `CDFException.cs` and should be used in your applications rather than using the true numeric values. Appendix A explains each status code. When the status code returned from a CDF API is tested, the following rules apply.

<code>status > CDF_OK</code>	Indicates successful completion but some additional information is provided. These are informational codes.
<code>status = CDF_OK</code>	Indicates successful completion.
<code>CDF_WARN < status < CDF_OK</code>	Indicates that the function completed but probably not as expected. These are warning codes.
<code>status < CDF_WARN</code>	Indicates that the function did not complete. These for most cases are error codes, thus an exception might be thrown.

The following example shows how you could check the status code returned from CDF functions.

```
int status;

try {
    status = CDFfunction (...);    /* any CDF function returning int */
} catch (CDFException ex) {
    ....
}
```

In your own status handler you can take whatever action is appropriate to the application. An example status handler follows. Note that no action is taken in the status handler if the status is `CDF_OK`.

```
int status = ex.GetCurrentStatus();
string errorMsg = ex.GetStatusMsg(status);
```

Explanations for all CDF status codes are available to your applications through the method `CDFError`. `CDFError` encodes in a text string an explanation of a given status code.

Chapter 6

6 EPOCH Utility Routines

Several functions exist that compute, decompose, parse, and encode CDF_EPOCH and CDF_EPOCH16 values. These functions may be called by applications using the CDF_EPOCH and CDF_EPOCH16 data types and are included in the CDF library. The Concepts chapter in the CDF User's Guide describes EPOCH values. All these APIs are defined as static methods in **CDFAPIs** class. The date/time components for CDF_EPOCH and CDF_EPOCH16 are **UTC-based**, without leap seconds.

The CDF_EPOCH and CDF_EPOCH16 data types are used to store time values referenced from a particular epoch. For CDF that epoch values for CDF_EPOCH and CDF_EPOCH16 are 01-Jan-0000 00:00:00.000 and 01-Jan-0000 00:00:00.000.000.000.000, respectively.

6.1 computeEPOCH

```
double computeEPOCH(
int year,
int month,
int day,
int hour,
int minute,
int second,
int msec);
/* out -- CDF_EPOCH value returned. */
/* in -- Year (AD, e.g., 1994). */
/* in -- Month (1-12). */
/* in -- Day (1-31). */
/* in -- Hour (0-23). */
/* in -- Minute (0-59). */
/* in -- Second (0-59). */
/* in -- Millisecond (0-999). */

double[] computeEPOCH(
int[] year,
int[] month,
int[] day,
int[] hour,
int[] minute,
int[] second,
int[] msec);
/* out -- Array of CDF_EPOCH values. */
/* in -- Years (AD, e.g., 1994). */
/* in -- Months (1-12). */
/* in -- Days (1-31). */
/* in -- Hours (0-23). */
/* in -- Minutes (0-59). */
/* in -- Seconds (0-59). */
/* in -- Milliseconds (0-999). */
```

computeEPOCH calculates a single or an array of CDF_EPOCH values given the individual components. If an illegal component is detected, the value returned will be ILLEGAL_EPOCH_VALUE.

NOTE: There are two variations on how computeEPOCH may be used. If the month argument is 0 (zero), then the day argument is assumed to be the day of the year (DOY) having a range of 1 through 366. Also, if the hour, minute, and second arguments are all 0 (zero), then the msec argument is assumed to be the millisecond of the day having a range of 0 through 86400000.

6.2 EPOCHbreakdown

```
void EPOCHbreakdown(
double epoch,
TYPE year,
TYPE month,
TYPE day,
TYPE hour,
TYPE minute,
TYPE second,
TYPE msec);
/* in -- The CDF_EPOCH value. */
/* out -- Year (AD, e.g., 1994). */
/* out -- Month (1-12). */
/* out -- Day (1-31). */
/* out -- Hour (0-23). */
/* out -- Minute (0-59). */
/* out -- Second (0-59). */
/* out -- Millisecond (0-999). */
/* TYPE -- int* or "out int". */

void EPOCHbreakdown(
double[] epoch,
out int[] year,
out int[] month,
out int[] day,
out int[] hour,
out int[] minute,
out int[] second,
out int[] msec);
/* in -- Array of CDF_EPOCH values. */
/* out -- Years (AD, e.g., 1994). */
/* out -- Months (1-12). */
/* out -- Days (1-31). */
/* out -- Hours (0-23). */
/* out -- Minutes (0-59). */
/* out -- Seconds (0-59). */
/* out -- Milliseconds (0-999). */
```

EPOCHbreakdown decomposes a single or an array of CDF_EPOCH values into the individual components.

6.3 toEncodeEPOCH

```
string toEncodeEPOCH(
double epoch);
/* out -- The date/time string (style is 4). */
/* in -- The CDF_EPOCH value. */

string[] toEncodeEPOCH(
double[] epoch);
/* out -- The date/time strings (style is 4). */
/* in -- Array CDF_EPOCH values. */

string toEncodeEPOCH(
double epoch,
int style);
/* out -- The date/time string. */
/* in -- The CDF_EPOCH value. */
/* in -- The encoded style (1-6). */

string[] toEncodeEPOCH(
/* out -- The date/time strings. */
```



```
double[] epoch,          /* in -- Array CDF_EPOCH values. */
int      style);        /* in -- The encoded style (1-4). */
```

toEncodeEPOCH encodes a single or array of CDF_EPOCH values into style 4 date/time character string(s), or the date/time string(s) of designated style. For style: 0, it is the same as calling encodeEPOCH. For style 1, 2, 3 or 4, it is the same as calling encodeEPOCH1, encodeEPOCH2, encodeEPOCH3 and encodeEPOCH4, respectively.

6.4 encodeEPOCH

```
void encodeEPOCH(
double epoch;          /* in -- The CDF_EPOCH value. */
out string epString;  /* out -- The standard date/time string. */
```

```
void encodeEPOCH(
double[] epoch;        /* in -- Array CDF_EPOCH values. */
out string[] epString; /* out -- The standard date/time strings. */
```

encodeEPOCH encodes a single or array of CDF_EPOCH values into the standard date/time character string(s). The format of the string is **dd-mmm-yyyy hh:mm:ss.ccc** where dd is the day of the month (1-31), mmm is the month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec), yyyy is the year, hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), and ccc is the millisecond (0-999).

6.5 encodeEPOCH1

```
void encodeEPOCH1(
double epoch;          /* in -- The CDF_EPOCH value. */
out string epString)  /* out -- The alternate date/time string. */
```

encodeEPOCH1 encodes a CDF_EPOCH value into an alternate date/time character string. The format of the string is **yyyymmdd.tttttt**, where yyyy is the year, mm is the month (1-12), dd is the day of the month (1-31), and tttttt is the fraction of the day (e.g., 5000000 is 12 o'clock noon).

6.6 encodeEPOCH2

```
void encodeEPOCH2(
double epoch;          /* in -- The CDF_EPOCH value. */
out string epString)  /* out -- The alternate date/time string. */
```

encodeEPOCH2 encodes a CDF_EPOCH value into an alternate date/time character string. The format of the string is **yyyymmddhhmmss** where yyyy is the year, mo is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), and ss is the second (0-59).

6.7 encodeEPOCH3

```
void encodeEPOCH3(  
double epoch; /* in -- The CDF_EPOCH value. */  
out string epString) /* out -- The alternate date/time string. */
```

encodeEPOCH3 encodes a CDF_EPOCH value into an alternate date/time character string. The format of the string is yyyy-mo-ddThh:mm:ss.cccZ where yyyy is the year, mo is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), and ccc is the millisecond (0-999).

6.8 encodeEPOCH4

```
void encodeEPOCH4(  
double epoch; /* in -- The CDF_EPOCH value. */  
out string epString) /* out -- The ISO 8601 date/time string. */
```

encodeEPOCH3 encodes a CDF_EPOCH value into an alternate, ISO 8601 date/time character string. The format of the string is yyyy-mo-ddThh:mm:ss.ccc where yyyy is the year, mo is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), and ccc is the millisecond (0-999).

6.9 encodeEPOCHx

```
void encodeEPOCHx(  
double epoch; /* in -- The CDF_EPOCH value. */  
string format; /* in -- The format string. */  
out string encoded); /* out -- The custom date/time string. */
```

encodeEPOCHx encodes a CDF_EPOCH value into a custom date/time character string. The format of the encoded string is specified by a format string.

The format string consists of EPOCH components, which are encoded, and text that is simply copied to the encoded custom string. Components are enclosed in angle brackets and consist of a component token and an optional width. The syntax of a component is: <token[.width]>. If the optional width contains a leading zero, then the component will be encoded with leading zeroes (rather than leading blanks).

The supported component tokens and their default widths are as follows. . .

Token	Meaning	Default
dom	Day of month (1-31)	<dom.0>
doy	Day of year (001-366)	<doy.03>
month	Month ('Jan','Feb',..., 'Dec')	<month>
mm	Month (1,2,...,12)	<mm.0>
year	Year (4-digit)	<year.04>
yr	Year (2-digit)	<yr.02>
hour	Hour (00-23)	<hour.02>
min	Minute (00-59)	<min.02>
sec	Second (00-59)	<sec.02>

fos	Fraction of second.	<fos.3>
fod	Fraction of day.	<fod.8>

Note that a width of zero indicates that as many digits as necessary should be used to encoded the component. The <month> component is always encoded with three characters. The <fos> and <fod> components are always encoded with leading zeroes.

If a left angle bracket is desired in the encoded string, then simply specify two left angle brackets (<<) in the format string (character stuffing).

For example, the format string used to encode the standard EPOCH date/time character string (see Section 6.3) would be. . .

```
<dom.02>-<month>-<year> <hour>:<min>:<sec>.<fos>
```

6.10 toParseEPOCH

```
double toParseEPOCH(                               /* out -- CDF_EPOCH value returned. */
string epString);                                  /* in -- The standard date/time string. */
```

```
double[] toParseEPOCH(                             /* out -- Array of CDF_EPOCH values */
string[] epString);                                /* in -- The encoded date/time strings. */
```

toParseEPOCH parses a single or an array of string(s) in various, standard date/time forms and returns a CDF_EPOCH value(s). The string can be one of the forms that is produced by the encodeEPOCH, encodeEPOCH1, encodeEPOCH2, encodeEPOCH3 and encodeEPOCH4 methods described ealier in this Section. If an illegal field is detected in the string the value returned will be ILLEGAL_EPOCH_VALUE.

6.11 parseEPOCH

```
double parseEPOCH(                                 /* out -- CDF_EPOCH value returned. */
string epString);                                  /* in -- The standard date/time string. */
```

```
double[] parseEPOCH(                               /* out -- Array of CDF_EPOCH values */
string[] epString);                                /* in -- The standard date/time strings. */
```

parseEPOCH parses a single or an array of standard date/time character string(s) and returns a CDF_EPOCH value(s). The format of the string is that produced by the encodeEPOCH method described in Section 6.3. If an illegal field is detected in the string the value returned will be ILLEGAL_EPOCH_VALUE.

6.12 parseEPOCH1

```
double parseEPOCH1(                               /* out -- CDF_EPOCH value returned. */
string epString);                                  /* in -- The alternate date/time string. */
```



```

int second,
int msec,
int microsec,
int nanosec,
int picosec,
TYPE epoch);

```

```

/* in -- Second (0-59). */
/* in -- Millisecond (0-999). */
/* in -- Microsecond (0-999). */
/* in -- Nanosecond (0-999). */
/* in -- Picosecond (0-999). */
/* out -- CDF_EPOCH16 value returned */
/* TYPE -- double* or "out double[]". */

```

computeEPOCH16 calculates a CDF_EPOCH16 value given the individual components. If an illegal component is detected, the value returned will be ILLEGAL_EPOCH_VALUE.

6.17 EPOCH16breakdown

```

void EPOCH16breakdown(
double[] epoch,
TYPE year,
TYPE month,
TYPE day,
TYPE hour,
TYPE minute,
TYPE second,
TYPE msec,
TYPE microsec,
TYPE nanosec,
TYPE picosec);

```

```

/* in -- The CDF_EPOCH16 value. */
/* out -- Year (AD, e.g., 1994). */
/* out -- Month (1-12). */
/* out -- Day (1-31). */
/* out -- Hour (0-23). */
/* out -- Minute (0-59). */
/* out -- Second (0-59). */
/* out -- Millisecond (0-999). */
/* out -- Microsecond (0-999). */
/* out -- Nanosecond (0-999). */
/* out -- Picosecond (0-999). */
/* TYPE -- int* or "out int". */

```

EPOCH16breakdown decomposes a CDF_EPOCH16 value into the individual components.

6.18 toEncodeEPOCH16

```

string toEncodeEPOCH16(
double[] epoch);

```

```

/* out -- The date/time string (style is 4). */
/* in -- The CDF_EPOCH value. */

```

```

string toEncodeEPOCH16(
double[] epoch,
int style);

```

```

/* out -- The date/time string. */
/* in -- The CDF_EPOCH value. */
/* in -- The encoded style (1-6). */

```

toEncodeEPOCH16 encodes a single of CDF_EPOCH16 epoch, a two-double array, into an ISO8601 date/time character string, as style 4, or the date/time string of the designated style. For style: 0, it is the same as calling encodeEPOCH16. For style 1, 2, 3 or 4, it is the same as calling encodeEPOCH16_1, encodeEPOCH16_2, encodeEPOCH16_3 and encodeEPOCH16_4, respectively.

6.19 encodeEPOCH16

```

void encodeEPOCH16(

```

```
double[] epoch, /* in -- The CDF_EPOCH16 value. */
out string epString); /* out -- The date/time string. */
```

encodeEPOCH16 encodes a CDF_EPOCH16 value into the standard date/time character string. The format of the string is **dd-mmm-yyyy hh:mm:ss.mmm:uuu:nnn:ppp** where dd is the day of the month (1-31), mmm is the month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec), yyyy is the year, hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), nnn is the nanosecond (0-999), and ppp is the picosecond (0-999).

6.20 encodeEPOCH16_1

```
void encodeEPOCH16_1(
double[] epoch, /* in -- The CDF_EPOCH16 value. */
out string epString); /* out -- The date/time string. */
```

encodeEPOCH16_1 encodes a CDF_EPOCH16 value into an alternate date/time character string. The format of the string is **yyyymmdd.tttttttttt**, where yyyy is the year, mm is the month (1-12), dd is the day of the month (1-31), and tttttttttt is the fraction of the day (e.g., 5000000000000000 is 12 o'clock noon).

6.21 encodeEPOCH16_2

```
void encodeEPOCH16_2(
double[] epoch, /* in -- The CDF_EPOCH16 value. */
out string epString); /* out -- The date/time string. */
```

encodeEPOCH16_2 encodes a CDF_EPOCH16 value into an alternate date/time character string. The format of the string is **yyyymmddhhmmss** where yyyy is the year, mm is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), and ss is the second (0-59).

6.22 encodeEPOCH16_3

```
void encodeEPOCH16_3(
double[] epoch, /* in -- The CDF_EPOCH16 value. */
out string epString); /* out -- The alternate date/time string. */
```

encodeEPOCH16_3 encodes a CDF_EPOCH16 value into an alternate date/time character string. The format of the string is **yyyy-mo-ddThh:mm:ss.mmm:uuu:nnn:pppZ** where yyyy is the year, mo is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), nnn is the nanosecond (0-999), and ppp is the picosecond (0-999).

6.23 encodeEPOCH16_4

```
void encodeEPOCH16_4(
double[] epoch,          /* in -- The CDF_EPOCH16 value. */
out string epString);   /* out -- The alternate date/time string. */
```

encodeEPOCH16_4 encodes a CDF_EPOCH16 value into an alternate, ISO 8601 date/time character string. The format of the string is yyyy-mo-ddThh:mm:ss.mmmuuunnnppp where yyyy is the year, mo is the month (1-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), nnn is the nanosecond (0-999), and ppp is the picosecond (0-999).

6.24 encodeEPOCH16_x

```
void encodeEPOCH16_x(
double[] epoch,          /* in -- The CDF_EPOCH16 value. */
string format;          /* in -- The format string. */
out string encoded);    /* out -- The date/time string. */
```

encodeEPOCH16_x encodes a CDF_EPOCH16 value into a custom date/time character string. The format of the encoded string is specified by a format string.

The format string consists of EPOCH components, which are encoded, and text that is simply copied to the encoded custom string. Components are enclosed in angle brackets and consist of a component token and an optional width. The syntax of a component is: <token[.width]>. If the optional width contains a leading zero, then the component will be encoded with leading zeroes (rather than leading blanks).

The supported component tokens and their default widths are as follows. . .

<u>Token</u>	<u>Meaning</u>	<u>Default</u>
dom	Day of month (1-31)	<dom.0>
doy	Day of year (001-366)	<doy.03>
month	Month ('Jan', 'Feb', ..., 'Dec')	<month>
mm	Month (1,2,...,12)	<mm.0>
year	Year (4-digit)	<year.04>
yr	Year (2-digit)	<yr.02>
hour	Hour (00-23)	<hour.02>
min	Minute (00-59)	<min.02>
sec	Second (00-59)	<sec.02>
msec	Millisecond (000-999)	<msec.3>
usc	Microsecond (000-999)	<usc.3>
nsc	Nanosecond (000-999)	<nsc.3>
psc	Picosecond (000-999)	<psc.3>
fos	Fraction of second.	<fos.12>
fod	Fraction of day.	<fod.8>

Note that a width of zero indicates that as many digits as necessary should be used to encoded the component. The <month> component is always encoded with three characters. The <fos> and <fod> components are always encoded with leading zeroes.

If a left angle bracket is desired in the encoded string, then simply specify two left angle brackets (<<) in the format string (character stuffing).


```
string epString,  
TYPE epoch);
```

```
/* in -- The date/time string. */  
/* out -- The CDF_EPOCH16 value returned */  
/* TYPE -- double* or "out double[]". */
```

parseEPOCH16_2 parses an alternate date/time character string and returns a CDF_EPOCH16 value. The format of the string is that produced by the encodeEPOCH16_2 function. If an illegal field is detected in the string the value returned will be ILLEGAL_EPOCH_VALUE.

6.29 parseEPOCH16_3

```
double parseEPOCH16_3(  
string epString,  
TYPE epoch);
```

```
/* out -- The status code returned. */  
/* in -- The date/time string. */  
/* out -- The CDF_EPOCH16 value returned */  
/* TYPE -- double* or "out double[]". */
```

parseEPOCH16_3 parses an alternate date/time character string and returns a CDF_EPOCH16 value. The format of the string is that produced by the encodeEPOCH16_3 function. If an illegal field is detected in the string the value returned will be ILLEGAL_EPOCH_VALUE.

6.30 parseEPOCH16_4

```
double parseEPOCH16_4(  
string epString,  
TYPE epoch);
```

```
/* out -- The status code returned. */  
/* in -- The ISO 8601 date/time string. */  
/* out -- The CDF_EPOCH16 value returned */  
/* TYPE -- double* or "out double[]". */
```

parseEPOCH16_4 parses an alternate date/time character string and returns a CDF_EPOCH16 value. The format of the string is that produced by the encodeEPOCH16_3 function. If an illegal field is detected in the string the value returned will be ILLEGAL_EPOCH_VALUE.

6.31 EPOCHtoUnixTime

```
double EPOCHtoUnixTime(  
double epoch);
```

```
/* out -- The converted Unix time. */  
/* in -- The CDF_EPOCH epoch value. */
```

```
double[] EPOCHtoUnixTime(  
double[] epochs);
```

```
/* out -- The converted Unix times. */  
/* in -- The CDF_EPOCH epoch values. */
```

EPOCHtoUnixTime converts a CDF_EPOCH epoch time(s) to a Unix time(s). A CDF_EPOCH epoch, a double, is milliseconds from 0000-01-01T00:00:00.000 while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part.

6.32 UnixTimetoEPOCH

```
double UnixTimetoEPOCH (                               /* out -- The converted CDF_EPOCH epoch value. */
double unixTime);                                     /* in -- The Unix time. */

double[] UnixTimetoEPOCH (                             /* out -- The converted CDF_EPOCH epoch values. */
double[] unixTime);                                  /* in -- The Unix times. */
```

UnixTimetoEPOCH converts a Unix time(s) to a CDF_EPOCH epoch time(s). A CDF_EPOCH epoch, a double, is milliseconds from 0000-01-01T00:00:00.000 while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part. Converting the Unix time to EPOCH will only keep the resolution to milliseconds.

6.33 EPOCH16toUnixTime

```
double EPOCH16toUnixTime(                             /* out -- The converted Unix time. */
double[] epoch);                                     /* in -- The CDF_EPOCH16 epoch value. */
```

EPOCH16toUnixTime converts a CDF_EPOCH16 epoch time, a two-double array, to a Unix time. A CDF_EPOCH16 epoch, a two-double, is picoseconds from 0000-01-01T00:00:00.000.000.000.000 while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part. **Note:** As CDF_EPOCH16 has much higher time resolution, sub-microseconds portion of its time might get lost during the conversion.

6.34 UnixTimetoEPOCH16

```
double[] UnixTimetoEPOCH16 (                          /* out -- The converted CDF_EPOCH epoch value. */
double unixTime);                                     /* in -- The Unix time. */
```

UnixTimetoEPOCH16 converts a Unix time to a CDF_EPOCH16 epoch time, a two-double array. A CDF_EPOCH16 epoch, a two-double, is picoseconds from 0000-01-01T00:00:00.000.000.000.000 while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part. Sub-microseconds will be filled with 0's when converting from Unix time to EPOCH16.

7 TT2000 Utility Routines

Several functions exist that compute, decompose, parse, and encode CDF_TIME_TT2000 values. These functions may be called by applications using the CDF_TIME_TT2000 data type and is included in the CDF library. The Concepts chapter in the CDF User's Guide describes TT2000 values. All these APIs are defined as static methods in **CDFAPIs** class. The date/time components for CDF_TIME_TT2000 are **UTC-based**, with leap seconds.

The CDF_TIME_TT2000 data type is used to store time values referenced from **J2000** (2000-01-01T12:00:00.000000000). For CDF, values in CDF_TIME_TT2000 are nanoseconds from J2000 with **leap seconds** included. TT2000 data can cover years between 1707 and 2292.

7.1 computeTT2000

compueTT2000 is a overloaded function.

```
long computeTT2000(                                     /* out -- CDF_TIME_TT2000 value returned. */
TYPE year,                                             /* in -- Year (AD, e.g., 1994), with no fraction. */
TYPE month,                                           /* in -- Month (1-12), with no fraction. */
TYPE day);                                           /* in -- Day (1-31). */

long computeTT2000(                                     /* out -- CDF_TIME_TT2000 value returned. */
TYPE year,                                             /* in -- Year (AD, e.g., 1994), with no fraction. */
TYPE month,                                           /* in -- Month (1-12), with no fraction. */
TYPE day,                                             /* in -- Day (1-31), with no fraction. */
TYPE hour);                                          /* in -- Hour (0-23). */

long computeTT2000(                                     /* out -- CDF_TIME_TT2000 value returned. */
TYPE year,                                             /* in -- Year (AD, e.g., 1994), with no fraction. */
TYPE month,                                           /* in -- Month (1-12), with no fraction. */
TYPE day,                                             /* in -- Day (1-31), with no fraction. */
TYPE hour,                                           /* in -- Hour (0-23), with no fraction. */
TYPE minute);                                       /* in -- Minute (0-59). */

long computeTT2000(                                     /* out -- CDF_TIME_TT2000 value returned. */
TYPE year,                                             /* in -- Year (AD, e.g., 1994), with no fraction. */
TYPE month,                                           /* in -- Month (1-12), with no fraction. */
TYPE day,                                             /* in -- Day (1-31), with no fraction. */
TYPE hour,                                           /* in -- Hour (0-23), with no fraction. */
TYPE minute,                                         /* in -- Minute (0-59), with no fraction. */
TYPE second);                                       /* in -- Second (0-59 or 0-60 if leap second). */

long computeTT2000(                                     /* out -- CDF_TIME_TT2000 value returned. */
TYPE year,                                             /* in -- Year (AD, e.g., 1994), with no fraction. */
TYPE month,                                           /* in -- Month (1-12), with no fraction. */
TYPE day,                                             /* in -- Day (1-31), with no fraction. */
TYPE hour);                                          /* in -- Hour (0-23), with no fraction. */
```

```
TYPE minute,  
TYPE second,  
TYPE msec);
```

```
/* in -- Minute (0-59), with no fraction. */  
/* in -- Second (0-59 or 0-60), with no fraction. */  
/* in -- Millisecond (0-999). */
```

```
long computeTT2000(  
TYPE year,  
TYPE month,  
TYPE day,  
TYPE hour,  
TYPE minute,  
TYPE second,  
TYPE msec,  
TYPE usec);
```

```
/* out -- CDF_TIME_TT2000 value returned. */  
/* in -- Year (AD, e.g., 1994), with no fraction. */  
/* in -- Month (1-12), with no fraction. */  
/* in -- Day (1-31), with no fraction. */  
/* in -- Hour (0-23), with no fraction. */  
/* in -- Minute (0-59), with no fraction. */  
/* in -- Second (0-59 or 0-60), with no fraction. */  
/* in -- Millisecond (0-999), with no fraction. */  
/* in -- Microsecond (0-999). */
```

```
long computeTT2000(  
TYPE year,  
TYPE month,  
TYPE day,  
TYPE hour,  
TYPE minute,  
TYPE second,  
TYPE msec,  
TYPE usec,  
TYPE nsec);
```

```
/* out -- CDF_TIME_TT2000 value returned. */  
/* in -- Year (AD, e.g., 1994), with no fraction. */  
/* in -- Month (1-12), with no fraction. */  
/* in -- Day (1-31), with no fraction. */  
/* in -- Hour (0-23), with no fraction. */  
/* in -- Minute (0-59), with no fraction. */  
/* in -- Second (0-59 or 0-60), with no fraction. */  
/* in -- Millisecond (0-999), with no fraction. */  
/* in -- Microsecond (0-999), with no fraction. */  
/* in -- Nanosecond (0-999). */
```

Another set of functions (to be added in the future):

```
long[] computeTT2000(  
TYPE [] year,  
TYPE [] month,  
TYPE [] day);
```

```
/* out -- Array of CDF_TIME_TT2000 values. */  
/* in -- Years (AD, e.g., 1994), with no fraction. */  
/* in -- Months (1-12), with no fraction. */  
/* in -- Days (1-31). */
```

```
long[] computeTT2000(  
TYPE [] year,  
TYPE [] month,  
TYPE [] day,  
TYPE [] hour);
```

```
/* out -- Array of CDF_TIME_TT2000 values. */  
/* in -- Years (AD, e.g., 1994), with no fraction. */  
/* in -- Months (1-12), with no fraction. */  
/* in -- Days (1-31), with no fraction. */  
/* in -- Hours (0-23). */
```

```
long[] computeTT2000(  
TYPE [] year,  
TYPE [] month,  
TYPE [] day,  
TYPE [] hour,  
TYPE [] minute);
```

```
/* out -- Array of CDF_TIME_TT2000 values. */  
/* in -- Years (AD, e.g., 1994), with no fraction. */  
/* in -- Months (1-12), with no fraction. */  
/* in -- Days (1-31), with no fraction. */  
/* in -- Hours (0-23), with no fraction. */  
/* in -- Minute (0-59). */
```

```
long[] computeTT2000(  
TYPE [] year,  
TYPE [] month,  
TYPE [] day,  
TYPE [] hour,  
TYPE [] minute,  
TYPE [] second);
```

```
/* out -- Array of CDF_TIME_TT2000 values. */  
/* in -- Years (AD, e.g., 1994), with no fraction. */  
/* in -- Months (1-12), with no fraction. */  
/* in -- Days (1-31), with no fraction. */  
/* in -- Hours (0-23), with no fraction. */  
/* in -- Minutes (0-59), with no fraction. */  
/* in -- Seconds (0-59 or 0-60 if leap second). */
```

```
long[] computeTT2000(  
TYPE [] year,  
TYPE [] month,
```

```
/* out -- Array of CDF_TIME_TT2000 values. */  
/* in -- Years (AD, e.g., 1994), with no fraction. */  
/* in -- Months (1-12), with no fraction. */
```

```

TYPE [] day, /* in -- Days (1-31), with no fraction. */
TYPE [] hour, /* in -- Hours (0-23), with no fraction. */
TYPE [] minute, /* in -- Minutes (0-59), with no fraction. */
TYPE [] second, /* in -- Seconds (0-59 or 0-60) with no fraction. */
TYPE [] msec); /* in -- Milliseconds (0-999). */

long[] computeTT2000( /* out -- Array of CDF_TIME_TT2000 values. */
TYPE [] year, /* in -- Years (AD, e.g., 1994), with no fraction. */
TYPE [] month, /* in -- Months (1-12), with no fraction. */
TYPE [] day, /* in -- Days (1-31), with no fraction. */
TYPE [] hour, /* in -- Hours (0-23), with no fraction. */
TYPE [] minute, /* in -- Minutes (0-59), with no fraction. */
TYPE [] second, /* in -- Seconds (0-59 or 0-60), with no fraction. */
TYPE [] msec, /* in -- Milliseconds (0-999), with no fraction. */
TYPE [] usec); /* in -- Microseconds (0-999). */

long[] computeTT2000( /* out -- Array of CDF_TIME_TT2000 values. */
TYPE [] year, /* in -- Years (AD, e.g., 1994), with no fraction. */
TYPE [] month, /* in -- Months (1-12), with no fraction. */
TYPE [] day, /* in -- Days (1-31), with no fraction. */
TYPE [] hour, /* in -- Hours (0-23), with no fraction. */
TYPE [] minute, /* in -- Minutes (0-59), with no fraction. */
TYPE [] second, /* in -- Seconds (0-59 or 0-60). with no fraction. */
TYPE [] msec, /* in -- Milliseconds (0-999), with no fraction. */
TYPE [] usec, /* in -- Microseconds (0-999), with no fraction. */
TYPE [] nsec); /* in -- Nanoseconds (0-999), with no fraction. */

```

Note: TYPE can be either double or long.

computeTT2000 calculates a single or an array of CDF_TIME_TT2000 value(s), from the given individual components. If an illegal component is detected, the value returned will be ILLEGAL_TT2000_VALUE. The day component can be either in day of the month or day of the year (DOY). For DOY form, the month component must have a value(s) of one (1).

NOTE: Even though this overloaded function uses double for all its parameter fields, all but the very last parameter can not have a non-zero fractional part for simplifying the computation. An exception will be thrown if the rule is not followed. For example, this call is allowed:

```
long tt2000 = computeTT2000(2010.0, 10.0, 10.5);
```

But, this call will fail:

```
long tt2000 = computeTT2000(2010.0, 10.0, 10.5, 12.5);
```

7.2 TT2000breakdown

```

void TT2000breakdown(
long tt2000, /* in -- The CDF_TIME_TT2000 value. */
TYPE year, /* out -- Year (AD, e.g., 1994). */
TYPE month, /* out -- Month (1-12). */
TYPE day, /* out -- Day (1-31). */

```

```

TYPE hour,
TYPE minute,
TYPE second,
TYPE msec;
TYPE usec;
TYPE nsec);

```

```

/* out -- Hour (0-23). */
/* out -- Minute (0-59). */
/* out -- Second (0-59 or 0-60 if leap second). */
/* out -- Millisecond (0-999). */
/* out -- Microsecond (0-999). */
/* out -- Nanosecond (0-999). */
/* TYPE -- double* or "out double" or
long* or "out long" */

```

Another function will be added in the future:

```

void TT2000breakdown(
long[] tt2000,
out double[] year,
out double[] month,
out double[] day,
out double[] hour,
out double[] minute,
out double[] second,
out double[] msec;
out double[] usec;
out double[] nsec);

```

```

/* in -- Array of CDF_TIME_TT2000 values. */
/* out -- Years (AD, e.g., 1994). */
/* out -- Months (1-12). */
/* out -- Days (1-31). */
/* out -- Hours (0-23). */
/* out -- Minutes (0-59). */
/* out -- Seconds (0-59 or 0-60 if leap second). */
/* out -- Milliseconds (0-999). */
/* out -- Microseconds (0-999). */
/* out -- Nanoseconds (0-999). */

```

TT2000breakdown decomposes a single or an array of CDF_TIME_TT2000 value(s) into the individual components.

7.3 toEncodeTT2000

toEncodeTT2000 is a overloaded function.

```

string toEncodeTT2000(
long tt2000);

```

```

/* out -- Encoded style 3 date/time string. */
/* in -- The CDF_TIME_TT2000 value. */

```

```

string toEncodeTT2000(
long tt2000;
int style);

```

```

/* out -- Encoded date/time string. */
/* in -- A TT2000 value. */
/* in -- The encoded string style. */

```

```

string[] toEncodeTT2000(
long[] tt2000);

```

```

/* out -- Encoded style 3 date/time strings. */
/* in -- The CDF_TIME_TT2000 value. */

```

```

string[] toEncodeTT2000(
long[] tt2000;
int style);

```

```

/* out -- Encoded date/time strings. */
/* in -- Array of TT2000 values. */
/* in -- The encoded string style. */

```

toEncodeTT2000 encodes a single or an array of CDF_TIME_TT2000 value(s) into various date/time UTC character string(s). If style is not provided, the default style is 3, which is in **ISO 8601** format: **yyyy-mm-ddT hh:mm:ss.mmmuuunnn** where yyyy is the year (1707-2292), mm is the month (01-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59 or 0-60 if leap second), mmm is the millisecond (0-999), uuu is the microsecond (0-999) and nnn is the nanosecond (0-999). The valid style is from 0 to 4.

For a style of value **0**, the encoded UTC string is **DD-Mon-YYYY hh:mm:ss.mmmuuunnn**, where DD is the day of the month (1-31), Mon is the month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec), YYYY is the year, hh is the hour (0-23), mm is the minute (0-59 or 0-60 if leap second), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), and nnn is the nanosecond (0-999). The encoded string has a length of TT2000_0_STRING_LEN (**30**).

For a style of value **1**, the encoded UTC string is **YYYYMMDD.tttttttt**, where YYYY is the year, MM is the month (1-12) DD is the day of the month (1-31), and tttttttt is sub-day.(0-999999999). The encoded string has a length of TT2000_1_STRING_LEN (**19**).

For a style of value **2**, the encoded UTC string is **YYYYMMDDhhmmss**, where YYYY is the year, MM is the month (1-12) DD is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), and ss is the second (0-59 or 0-60 if leap second). The encoded string has a length of TT2000_2_STRING_LEN (**14**).

For a style of value **3**, the encoded UTC string is **ISO8601** form as **YYYY-MM-DDThh:mm:ss.mmmuuunnn**, where YYYY is the year, MM is the month (1-12), DD is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59 or 0-60 if leap second), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), and nnn is the nanosecond (0-999). The encoded string has a length of TT2000_3_STRING_LEN (**29**).

For a style of value **4**, the encoded UTC string is the same as style 3, but with an extra “**Z**” appended to the end. The encoded string has a length of TT2000_4_STRING_LEN (**30**).

7.4 encodeTT2000

encodeTT2000 is a overloaded function.

```
void encodeTT2000(
long tt2000;                               /* in -- The CDF_TIME_TT2000 value. */
out string epString);                       /* out -- The standard date/time string. */

void encodeTT2000(
long[] tt2000;                              /* in -- Array of TT2000 values. */
out string[] epString);                     /* out -- The standard date/time strings. */

void encodeTT2000(
long tt2000;                               /* in -- The CDF_TIME_TT2000 value. */
out string epString.                         /* out -- The standard date/time string. */
int format);                                /* in -- The encoded string format. */

void encodeTT2000(
long[] tt2000;                              /* in -- Array of TT2000 values. */
out string[] epString.                       /* out -- The standard date/time strings. */
int format);                                /* in -- The encoded string format. */
```

encodeTT2000 encodes a single or an array of CDF_TIME_TT2000 value(s) into the standard date/time UTC character string(s). If not provided, the default format of the string is in **ISO 8601** format: **yyyy-mm-ddT hh:mm:ss.mmmuuunnn** where yyyy is the year (1707-2292), mm is the month (01-12), dd is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59), ss is the second (0-59 or 0-60 if leap second), mmm is the millisecond (0-999), uuu is the microsecond (0-999) and nnn is the nanosecond (0-999).

For a format of value **0**, the encoded UTC string is **DD-Mon-YYYY hh:mm:ss.mmmuuunnn**, where DD is the day of the month (1-31), Mon is the month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, or Dec), YYYY is the year, hh is the hour (0-23), mm is the minute (0-59 or 0-60 if leap second), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), and nnn is the nanosecond (0-999). The encoded string has a length of TT2000_0_STRING_LEN (**30**).

For a format of value **1**, the encoded UTC string is **YYYYMMDD.tttttttt**, where YYYY is the year, MM is the month (1-12) DD is the day of the month (1-31), and tttttttt is sub-day.(0-999999999). The encoded string has a length of TT2000_1_STRING_LEN (**19**).

For a format of value **2**, the encoded UTC string is **YYYYMMDDhhmmss**, where YYYY is the year, MM is the month (1-12) DD is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59),and ss is the second (0-59 or 0-60 if leap second). The encoded string has a length of TT2000_2_STRING_LEN (**14**).

For a format of value **3**, the encoded UTC string is **YYYY-MM-DDThh:mm:ss.mmmuuunnn**, where YYYY is the year, MM is the month (1-12), DD is the day of the month (1-31), hh is the hour (0-23), mm is the minute (0-59 or 0-60 if leap second), ss is the second (0-59), mmm is the millisecond (0-999), uuu is the microsecond (0-999), and nnn is the nanosecond (0-999). The encoded string has a length of TT2000_3_STRING_LEN (**29**).

7.5 toParseTT2000

```
long toParseTT2000(                               /* out -- CDF_TIME_TT2000 value returned. */
string epString);                                  /* in -- The encoded date/time string. */
```

```
long[] toParseTT2000(                              /* out -- Array of TT2000 values. */
string[] epString);                                /* in -- The encoded date/time strings. */
```

toParseTT2000 parses a single or an array of encoded date/time character string(s) and returns a CDF_TIME_TT2000 value(s). The format of the string is that produced by the toEncodeTT2000 or encodeTT2000 method described in Section 7.3 and 7.4. If an illegal field is detected in the string the value returned will be ILLEGAL_TT2000_VALUE.

7.6 ParseTT2000

```
long parseTT2000(                                  /* out -- CDF_TIME_TT2000 value returned. */
string epString);                                  /* in -- The standard date/time string. */
```

```
long[] parseTT2000(                                /* out -- Array of TT2000 values. */
string[] epString);                                /* in -- The standard date/time strings. */
```

parseTT2000 parses a single or an array of standard date/time character string(s) and returns a CDF_TIME_TT2000 value(s). The format of the string is that produced by the toEncodeTT2000 or encodeTT2000 method described in Section 6.3. If an illegal field is detected in the string the value returned will be ILLEGAL_TT2000_VALUE.

7.7 TT2000toUnixTime

```
double TT2000toUnixTime( /* out -- The converted Unix time. */
long epoch) /* in -- The CDF_TIME_TT2000 epoch value. */

double[] TT2000toUnixTime( /* out -- The converted Unix times. */
long[] epochs) /* in -- The CDF_TIME_TT2000 epoch values. */
```

TT2000toUnixTime converts CDF_TIME_TT2000 epoch time(s) to Unix time(s). A CDF_TIME_TT2000 epoch, a long, is nanoseconds from J2000 with leap seconds, while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part. **Note:** As CDF_TIME_TT2000 has much higher time resolution, sub-microseconds portion of its time might get lost during the conversion. Also, TT2000's leap seconds will get lost after the conversion.

7.8 UnixTimetoTT2000

```
long UnixTimetoTT2000 ( /* out -- The converted TT2000 epoch value. */
double unixTime) /* in -- The Unix time. */

long[] UnixTimetoTT2000 ( /* out -- The converted TT2000 epoch values. */
double[] unixTime) /* in -- The Unix times. */
```

UnixTimetoTT2000 converts Unix time(s) to CDF_TIME_TT2000 epoch time(s). A CDF_TIME_TT2000 epoch, a long, is nanoseconds from J2000 with leap seconds, while Unix time, also a double, is seconds from 1970-01-01T00:00:00.000. The Unix time can have sub-second, with a time resolution of microseconds, in its fractional part. Sub-microseconds will be filled with 0's when converting from Unix time to TT2000.

7.9 CDFgetLastDateinLeapSecondsTable

```
void CDFgetLastDateinLeapSecondsTable( /
out int year; /* out -- The year. */
out int month; /* out -- The month. */
out int day); /* out -- The day. */
```

CDFgetLastDateinLeapSecondsTable returns the last entry in the leap second table used by the CDF processing. This date comes from the leap second table, either through an external text file, or the hard-coded table in the library code. This information can tell whether the leap second table is up-to-date.

8 CDF Utility Methods

Several methods are created that are mainly used to decipher the strings and their corresponding constant values or vice versa. All these APIs are defined as static methods in **CDFUtils** class. The constant values are defined in **CDFConstants** class.

8.1 CDFFileExists

```
bool CDFFileExists( /* out -- The file existence flag. */  
string fileName) /* in -- The file name. */
```

CDFFileExists method checks whether a CDF file by the given file name, with or without the .cdf extension, exists. Even the file exists, CDFFileExists will not be able to verify whether it is a valid one. (Use CDFopen to validate it).

8.2 CDFgetChecksumValue

```
int CDFgetChecksumValue( /* out -- The checksum value. */  
string checksum) /* in -- The file checksum type string. */
```

CDFgetChecksumValue method returns the corresponding file checksum type value, based on the passed string. The file checksum types and their values are as follows:

<u>Type</u>	<u>Value</u>
NONE	NO_CHECKSUM (0)
MD5	MD5_CHECKSUM (1)
OTHER	OTHER_CHECKSUM

8.3 CDFgetCompressionTypeValue

```
int CDFgetCompressionTypeValue( /* out -- The compression type. */  
string compressionType) /* in -- The compression type string. */
```

CDFgetCompressionTypeValue method returns the corresponding compression type value, based on the passed string. The compression types and values are as follows:

<u>Type</u>	<u>Value</u>
NONE	NO_COMPRESSION (0)

RLE	RLE_COMPRESSION (1)
Huffman	HUFF_COMPRESSION (2)
Adaptive Huffman	AHUFF_COMPRESSION (3)
GZIP	GZIP_COMPRESSION (5)

8.4 CDFgetDataTypeValue

```
int CDFgetDataTypeValue(                                     /* out -- The data type. */
string dataType)                                           /* in -- The data type string. */
```

CDFgetDataTypeValue method returns the corresponding data type value, based on the passed string. The data types and their values are as follows:

<u>Type</u>	<u>Value</u>
CDF_BYTE	CDF_BYTE (41)
CDF_CHAR	CDF_CHAR (51)
CDF_UCHAR	CDF_UCHAR (52)
CDF_INT1	CDF_INT1 (1)
CDF_UINT1	CDF_UINT1 (11)
CDF_INT2	CDF_INT2 (2)
CDF_UINT2	CDF_UINT2 (12)
CDF_INT4	CDF_INT4 (4)
CDF_UINT4	CDF_UINT4 (14)
CDF_INT8	CDF_INT8 (8)
CDF_REAL4	CDF_REAL4 (21)
CDF_FLOAT	CDF_FLOAT (44)
CDF_REAL8	CDF_REAL8 (22)
CDF_DOUBLE	CDF_DOUBLE (45)
CDF_EPOCH	CDF_EPOCH (31)
CDF_EPOCH16	CDF_EPOCH16 (32)
CDF_TIME_TT2000	CDF_TIME_TT2000 (33)

8.5 CDFgetDecodingValue

```
int CDFgetDecodingValue(                                   /* out -- The decoding value. */
string decoding)                                          /* in -- The data decoding string. */
```

CDFgetDecodingValue method returns the corresponding data decoding value, based on the passed string. The data decodings and their values are as follows:

<u>Type</u>	<u>Value</u>
NETWORK	NETWORK_DECODING (1)
SUN	SUN_DECODING (2)
VAX	VAX_DECODING (3)
DECSTATION	DECSTATION_DECODING (4)
SGi	SGi_DECODING (5)
IBMPc	IBMPc_DECODING (6)
IBMRS	IBMRS_DECODING (7)

HOST	HOST_DECODING (8)
PPC	PPC_DECODING (9)
HP	HP_DECODING (11)
NeXT	NeXT_DECODING (12)
ALPHAOSF1	ALPHAOSF1_DECODING (13)
ALPHAVMSd	ALPHAVMSd_DECODING (14)
ALPHAVMSg	ALPHAVMSg_DECODING (15)
ALPHAVMSi	ALPHAVMSi_DECODING (16)

8.6 CDFgetEncodingValue

```
int CDFgetEncodingValue(                                     /* out -- The encoding value. */
string encoding)                                           /* in  -- The data encoding string. */
```

CDFgetEncodingValue method returns the corresponding data encoding value, based on the passed string. The data encodings and their values are as follows:

<u>Type</u>	<u>Value</u>
NETWORK	NETWORK_ENCODING (1)
SUN	SUN_ENCODING (2)
VAX	VAX_ENCODING (3)
DECSTATION	DECSTATION_ENCODING (4)
SGi	SGi_ENCODING (5)
IBMPc	IBMPc_ENCODING (6)
IBMRS	IBMRS_ENCODING (7)
HOST	HOST_ENCODING (8)
PPC	PPC_ENCODING (9)
HP	HP_ENCODING (11)
NeXT	NeXT_ENCODING (12)
ALPHAOSF1	ALPHAOSF1_ENCODING (13)
ALPHAVMSd	ALPHAVMSd_ENCODING (14)
ALPHAVMSg	ALPHAVMSg_ENCODING (15)
ALPHAVMSi	ALPHAVMSi_ENCODING (16)

8.7 CDFgetFormatValue

```
int CDFgetFormatValue(                                     /* out -- The format value. */
string format)                                           /* in  -- The file format string. */
```

CDFgetFormatValue method returns the corresponding file format value, based on the passed string. The file formats and their values are as follows:

<u>Type</u>	<u>Value</u>
SINGLE	SINGLE_FILE (1)
MULTI	MULTI_FILE (2)

8.8 CDFgetMajorityValue

```
int CDFgetMajorityValue( /* out -- The majority value. */
string majority) /* in -- The data majority string. */
```

CDFgetMajorityValue method returns the corresponding file majority value, based on the passed string. The file majorities and their values are as follows:

<u>Type</u>	<u>Value</u>
ROW	ROW_MAJOR (1)
COLUMN	COLUMN_MAJOR (2)

8.9 CDFgetSparseRecordValue

```
int CDFgetSparseRecordValue( /* out -- The sparse record value. */
string sparseRecord) /* in -- The sparse record string. */
```

CDFgetSparseRecordValue method returns the corresponding sparse record value, based on the passed string. The sparse records types and their values are as follows:

<u>Type</u>	<u>Value</u>
NONE	NO_SPARSERECORDS (0)
PAD	PAD_SPARSERECORDS (1)
PREV	PREV_SPARSERECORDS (2)

8.10 CDFgetStringChecksum

```
string CDFgetStringChecksum( /* out -- The checksum string. */
int checksum) /* in -- The file checksum type. */
```

CDFgetStringChecksum method returns the corresponding file checksum string, based on the passed type. The file checksum types and their values are the same as those defined in CDFgetChecksumValue method.

8.11 CDFgetStringCompressionType

```
string CDFgetStringCompressionType( /* out -- The compression string. */
int compressionType) /* in -- The compression type. */
```

CDFgetStringCompressionType method returns the corresponding compression type string, based on the passed type. The file checksum types and their values are the same as those defined in CDFgetCompressionTypeValue method.

8.12 CDFgetStringDataType

```
string CDFgetStringDataType(                                     /* out -- The data type string. */  
int dataType)                                                 /* in -- The data type. */
```

CDFgetStringDataType method returns the corresponding data type string, based on the passed type. The data types and their values are the same as those in CDFgetDataTypeValue method:

8.13 CDFgetStringDecoding

```
string CDFgetStringDecoding(                                   /* out -- The decoding string. */  
in decoding)                                                 /* in -- The data decoding type. */
```

CDFgetStringDecoding method returns the corresponding data decoding string, based on the passed type. The data decodings and their values are as same as those defined in CDFgetDecodingValue:

8.14 CDFgetStringEncoding

```
string CDFgetStringEncoding(                                   /* out -- The encoding string. */  
int encoding)                                                 /* in -- The data encoding type. */
```

CDFgetStringEncoding method returns the corresponding data encoding string, based on the passed type. The data encodings and their values are the same as those defined in CDFgetEncodingValue method.

8.15 CDFgetStringFormat

```
string CDFgetStringFormat(                                     /* out -- The format string. */  
int format)                                                  /* in -- The file format type. */
```

CDFgetStringFormat method returns the corresponding file format string, based on the passed type. The file formats and their values are the same as those defined in CDFgetFormatValue method.:

8.16 CDFgetStringMajority

```
string CDFgetStringMajority(                                   /* out -- The majority string. */  
int majority)                                                 /* in -- The data majority type. */
```

CDFgetStringMajority method returns the corresponding file majority string, based on the passed type. The file majorities and their values are the same as those defined in CDFgetMajorityValue method.

8.17 CDFgetStringSparseRecord

```
string CDFgetStringSparseRecord(          /* out -- The sparse record string. */  
int sparseRecord)                        /* in  -- The sparse record type.  */
```

CDFgetStringSparseRecord method returns the corresponding sparse record string, based on the passed type. The sparse records types and their values are the same as those defined in CDFgetSparseRecordValue method.:

9 CDF Exception Methods

Several methods in the CDFexception class can be used to check what happens when an exception is thrown by the CDF APIs, and react to it if necessary. All these APIs are defined as static methods. CDFException inherits from C#'s Exception class.

9.1 CDFgetCurrentStatus

```
int CDFgetCurrentStatus() /* out -- The status. */
```

CDFgetCurrentStatus method returns the status when an exception is detected. The status value should be a negative value. Chapter 5 covers all possible status codes. Use the following CDFgetStatusMsg method to decipher what the status means.

9.2 CDFgetStatusMsg

```
string CDFgetStatusMsg(/* out -- The descriptive message. */  
int status) /* in -- The exception status. */
```

CDFgetStatusMsg method returns the descriptive information of the passed status.

Appendix A

A.1 Introduction

A status code is returned from most CDF functions. The CDFConstants class contains the numerical values (constants) for each of the status codes (and for any other constants referred to in the explanations). The method CDFError can be used within a program to inquire the explanation text for a given status code.

There are three classes of status codes: informational, warning, and error. The purpose of each is as follows:

Informational	Indicates success but provides some additional information that may be of interest to an application.
Warning	Indicates that the method completed but possibly not as expected.
Error	Indicates that a fatal error occurred and the function aborted.

Status codes fall into classes as follows:

Error codes < CDF_WARN < Warning codes < CDF_OK < Informational codes

CDF_OK indicates an unqualified success (it should be the most commonly returned status code). CDF_WARN is simply used to distinguish between warning and error status codes.

A.2 Status Codes and Messages

The following list contains an explanation for each possible status code. Whether a particular status code is considered informational, a warning, or an error is also indicated.

ATTR_EXISTS	Named attribute already exists - cannot create or rename. Each attribute in a CDF must have a unique name. Note that trailing blanks are ignored by the CDF library when comparing attribute names. [Error]
ATTR_NAME_TRUNC	Attribute name truncated to CDF_ATTR_NAME_LEN256 characters. The attribute was created but with a truncated name. [Warning]
BAD_ALLOCATE_RECS	An illegal number of records to allocate for a variable was specified. For RV variables the number must be one or greater. For NRV variables the number must be exactly one. [Error]
BAD_ARGUMENT	An illegal/undefined argument was passed. Check that all arguments are properly declared and initialized. [Error]

BAD_ATTR_NAME	Illegal attribute name specified. Attribute names must contain at least one character, and each character must be printable. [Error]
BAD_ATTR_NUM	Illegal attribute number specified. Attribute numbers must be zero (0) or greater for C applications and one (1) or greater for Fortran applications. [Error]
BAD_BLOCKING_FACTOR ²⁶	An illegal blocking factor was specified. Blocking factors must be at least zero (0). [Error]
BAD_CACHESIZE	An illegal number of cache buffers was specified. The value must be at least zero (0). [Error]
BAD_CDF_EXTENSION	An illegal file extension was specified for a CDF. In general, do not specify an extension except possibly for a single-file CDF that has been renamed with a different file extension or no file extension. [Error]
BAD_CDF_ID	CDF identifier is unknown or invalid. The CDF identifier specified is not for a currently open CDF. [Error]
BAD_CDF_NAME	Illegal CDF name specified. CDF names must contain at least one character, and each character must be printable. Trailing blanks are allowed but will be ignored. [Error]
BAD_INT	Unknown CDF status code received. The CDF library does not use the status code specified. [Error]
BAD_CHECKSUM	An illegal checksum mode received. It is invalid or currently not supported. [Error]
BAD_COMPRESSION_PARM	An illegal compression parameter was specified. [Error]
BAD_DATA_TYPE	An unknown data type was specified or encountered. The CDF data types are defined in CDFConstants class for C# applications. [Error]
BAD_DECODING	An unknown decoding was specified. The CDF decodings are defined in CDFConstants class for C# applications. [Error]
BAD_DIM_COUNT	Illegal dimension count specified. A dimension count must be at least one (1) and not greater than the size of the dimension. [Error]
BAD_DIM_INDEX	One or more dimension index is out of range. A valid value must be specified regardless of the dimension variance. Note also that the combination of dimension index, count, and interval must not specify an element beyond the end of the dimension. [Error]
BAD_DIM_INTERVAL	Illegal dimension interval specified. Dimension intervals must be at least one (1). [Error]
BAD_DIM_SIZE	Illegal dimension size specified. A dimension size must be at least one (1). [Error]

²⁶ The status code BAD_BLOCKING_FACTOR was previously named BAD_EXTEND_RECS.

BAD_ENCODING	Unknown data encoding specified. The CDF encodings are defined in CDFConstants class for C# applications. [Error]
BAD_ENTRY_NUM	Illegal attribute entry number specified. Entry numbers must be at least zero (0) for C# applications. [Error]
BAD_FNC_OR_ITEM	The specified function or item is illegal. Check that the proper number of arguments are specified for each operation being performed. [Error]
BAD_FORMAT	Unknown format specified. The CDF formats are defined in CDFConstants class for C# applications. [Error]
BAD_INITIAL_RECS	An illegal number of records to initially write has been specified. The number of initial records must be at least one (1). [Error]
BAD_MAJORITY	Unknown variable majority specified. The CDF variable majorities are defined in CDFConstants class for C# applications. [Error]
BAD_MALLOC	Unable to allocate dynamic memory - system limit reached. Contact CDF User Support if this error occurs. [Error]
BAD_NEGtoPOSfp0_MODE	An illegal -0.0 to 0.0 mode was specified. The -0.0 to 0.0 modes are defined in CDFConstants class for C# applications. [Error]
BAD_NUM_DIMS	The number of dimensions specified is out of the allowed range. Zero (0) through CDF_MAX_DIMS dimensions are allowed. If more are needed, contact CDF User Support. [Error]
BAD_NUM_ELEMS	The number of elements of the data type is illegal. The number of elements must be at least one (1). For variables with a non-character data type, the number of elements must always be one (1). [Error]
BAD_NUM_VARS	Illegal number of variables in a record access operation. [Error]
BAD_READONLY_MODE	Illegal read-only mode specified. The CDF read-only modes are defined in CDFConstants class for C# applications. [Error]
BAD_REC_COUNT	Illegal record count specified. A record count must be at least one (1). [Error]
BAD_REC_INTERVAL	Illegal record interval specified. A record interval must be at least one (1). [Error]
BAD_REC_NUM	Record number is out of range. Record numbers must be at least zero (0) for C applications and at least one (1) for Fortran applications. Note that a valid value must be specified regardless of the record variance. [Error]
BAD_SCOPE	Unknown attribute scope specified. The attribute scopes are defined in CDFConstants class for C# applications. [Error]
BAD_SCRATCH_DIR	An illegal scratch directory was specified. The scratch directory must be writeable and accessible (if a relative path was specified)

	from the directory in which the application has been executed. [Error]
BAD_SPARSEARRAYS_PARM	An illegal sparse arrays parameter was specified. [Error]
BAD_VAR_NAME	Illegal variable name specified. Variable names must contain at least one character and each character must be printable. [Error]
BAD_VAR_NUM	Illegal variable number specified. Variable numbers must be zero (0) or greater for C# applications. [Error]
BAD_zMODE	Illegal zMode specified. The CDF zModes are defined in CDFConstants class for C# applications. [Error]
CANNOT_ALLOCATE_RECORDS	Records cannot be allocated for the given type of variable (e.g., a compressed variable). [Error]
CANNOT_CHANGE	<p>Because of dependencies on the value, it cannot be changed. Some possible causes of this error follow:</p> <ol style="list-style-type: none"> 1. Changing a CDF's data encoding after a variable value (including a pad value) or an attribute entry has been written. 2. Changing a CDF's format after a variable has been created or if a compressed single-file CDF. 3. Changing a CDF's variable majority after a variable value (excluding a pad value) has been written. 4. Changing a variable's data specification after a value (including the pad value) has been written to that variable or after records have been allocated for that variable. 5. Changing a variable's record variance after a value (excluding the pad value) has been written to that variable or after records have been allocated for that variable. 6. Changing a variable's dimension variances after a value (excluding the pad value) has been written to that variable or after records have been allocated for that variable. 7. Writing "initial" records to a variable after a value (excluding the pad value) has already been written to that variable. 8. Changing a variable's blocking factor when a compressed variable and a value (excluding the pad value) has been written or when a variable with sparse records and a value has been accessed. 9. Changing an attribute entry's data specification where the new specification is not equivalent to the old specification.
CANNOT_COMPRESS	The CDF or variable cannot be compressed. For CDFs, this occurs if the CDF has the multi-file format. For variables, this occurs if

	the variable is in a multi-file CDF, values have been written to the variable, or if sparse arrays have already been specified for the variable. [Error]
CANNOT_SPARSEARRAYS	Sparse arrays cannot be specified for the variable. This occurs if the variable is in a multi-file CDF, values have been written to the variable, records have been allocated for the variable, or if compression has already been specified for the variable. [Error]
CANNOT_SPARSERECORDS	Sparse records cannot be specified for the variable. This occurs if the variable is in a multi-file CDF, values have been written to the variable, or records have been allocated for the variable. [Error]
CDF_CLOSE_ERROR	Error detected while trying to close CDF. Check that sufficient disk space exists for the dotCDF file and that it has not been corrupted. [Error]
CDF_CREATE_ERROR	Cannot create the CDF specified - error from file system. Make sure that sufficient privilege exists to create the dotCDF file in the disk/directory location specified and that an open file quota has not already been reached. [Error]
CDF_DELETE_ERROR	Cannot delete the CDF specified - error from file system. Insufficient privileges exist to delete the CDF file(s). [Error]
CDF_EXISTS	The CDF named already exists - cannot create it. The CDF library will not overwrite an existing CDF. [Error]
CDF_INTERNAL_ERROR	An unexpected condition has occurred in the CDF library. Report this error to CDFsupport. [Error]
CDF_NAME_TRUNC	CDF file name truncated to CDF_PATHNAME_LEN characters. The CDF was created but with a truncated name. [Warning]
CDF_OK	Function completed successfully.
CDF_OPEN_ERROR	Cannot open the CDF specified - error from file system. Check that the dotCDF file is not corrupted and that sufficient privilege exists to open it. Also check that an open file quota has not already been reached. [Error]
CDF_READ_ERROR	Failed to read the CDF file - error from file system. Check that the dotCDF file is not corrupted. [Error]
CDF_WRITE_ERROR	Failed to write the CDF file - error from file system. Check that the dotCDF file is not corrupted. [Error]
CHECKSUM_ERROR	The data integrity verification through the checksum failed. [Error]
CHECKSUM_NOT_ALLOWED	The checksum is not allowed for old versioned files. [Error]
COMPRESSION_ERROR	An error occurred while compressing a CDF or block of variable records. This is an internal error in the CDF library. Contact CDF User Support. [Error]

CORRUPTED_V2_CDF	This Version 2 CDF is corrupted. An error has been detected in the CDF's control information. If the CDF file(s) are known to be valid, please contact CDF User Support. [Error]
DECOMPRESSION_ERROR	An error occurred while decompressing a CDF or block of variable records. The most likely cause is a corrupted dotCDF file. [Error]
DID_NOT_COMPRESS	For a compressed variable, a block of records did not compress to smaller than their uncompressed size. They have been stored uncompressed. This can result If the blocking factor is set too low or if the characteristics of the data are such that the compression algorithm chosen is unsuitable. [Informational]
EMPTY_COMPRESSED_CDF	The compressed CDF being opened is empty. This will result if a program, which was creating/modifying, the CDF abnormally terminated. [Error]
END_OF_VAR	The sequential access current value is at the end of the variable. Reading beyond the end of the last physical value for a variable is not allowed (when performing sequential access). [Error]
FORCED_PARAMETER	A specified parameter was forced to an acceptable value (rather than an error being returned). [Warning]
IBM_PC_OVERFLOW	An operation involving a buffer greater than 64k bytes in size has been specified for PCs running 16-bit DOS/Windows 3.*. [Error]
ILLEGAL_EPOCH_VALUE	Illegal component is detected in computing an epoch value or an illegal epoch value is provided in decomposing an epoch value. [Error]
ILLEGAL_FOR_SCOPE	The operation is illegal for the attribute's scope. For example, only gEntries may be written for gAttributes - not rEntries or zEntries. [Error]
ILLEGAL_IN_zMODE	The attempted operation is illegal while in zMode. Most operations involving rVariables or rEntries will be illegal. [Error]
ILLEGAL_ON_V1_CDF	The specified operation (i.e., opening) is not allowed on Version 1 CDFs. [Error]
MULTI_FILE_FORMAT	The specified operation is not applicable to CDFs with the multi-file format. For example, it does not make sense to inquire indexing statistics for a variable in a multi-file CDF (indexing is only used in single-file CDFs). [Informational]
NA_FOR_VARIABLE	The attempted operation is not applicable to the given variable. [Warning]
NEGATIVE_FP_ZERO	One or more of the values read/written are -0.0 (An illegal value on VAXes and DEC Alphas running OpenVMS). [Warning]
NO_ATTR_SELECTED	An attribute has not yet been selected. First select the attribute on which to perform the operation. [Error]

NO_CDF_SELECTED	A CDF has not yet been selected. First select the CDF on which to perform the operation. [Error]
NO_DELETE_ACCESS	Deleting is not allowed (read-only access). Make sure that delete access is allowed on the CDF file(s). [Error]
NO_ENTRY_SELECTED	An attribute entry has not yet been selected. First select the entry number on which to perform the operation. [Error]
NO_MORE_ACCESS	Further access to the CDF is not allowed because of a severe error. If the CDF was being modified, an attempt was made to save the changes made prior to the severe error. In any event, the CDF should still be closed. [Error]
NO_PADVALUE_SPECIFIED	A pad value has not yet been specified. The default pad value is currently being used for the variable. The default pad value was returned. [Informational]
NO_STATUS_SELECTED	A CDF status code has not yet been selected. First select the status code on which to perform the operation. [Error]
NO_SUCH_ATTR	The named attribute was not found. Note that attribute names are case-sensitive. [Error]
NO_SUCH_CDF	The specified CDF does not exist. Check that the file name specified is correct. [Error]
NO_SUCH_ENTRY	No such entry for specified attribute. [Error]
NO_SUCH_RECORD	The specified record does not exist for the given variable. [Error]
NO_SUCH_VAR	The named variable was not found. Note that variable names are case-sensitive. [Error]
NO_VAR_SELECTED	A variable has not yet been selected. First select the variable on which to perform the operation. [Error]
NO_VARS_IN_CDF	This CDF contains no rVariables. The operation performed is not applicable to a CDF with no rVariables. [Informational]
NO_WRITE_ACCESS	Write access is not allowed on the CDF file(s). Make sure that the CDF file(s) have the proper file system privileges and ownership. [Error]
NOT_A_CDF	Named CDF is corrupted or not actually a CDF. Contact CDF User Support if you are sure that the specified file is a CDF that should be readable by the CDF distribution being used. [Error]
NOT_A_CDF_OR_NOT_SUPPORTED	This can occur if an older CDF distribution is being used to read a CDF created by a more recent CDF distribution. Contact CDF User Support if you are sure that the specified file is a CDF that should be readable by the CDF distribution being used. CDF is backward compatible but not forward compatible. [Error]

PRECEEDING_RECORDS_ALLOCATED	Because of the type of variable, records preceding the range of records being allocated were automatically allocated as well. [Informational]
READ_ONLY_DISTRIBUTION	Your CDF distribution has been built to allow only read access to CDFs. Check with your system manager if you require write access. [Error]
READ_ONLY_MODE	The CDF is in read-only mode - modifications are not allowed. [Error]
SCRATCH_CREATE_ERROR	Cannot create a scratch file - error from file system. If a scratch directory has been specified, ensure that it is writeable. [Error]
SCRATCH_DELETE_ERROR	Cannot delete a scratch file - error from file system. [Error]
SCRATCH_READ_ERROR	Cannot read from a scratch file - error from file system. [Error]
SCRATCH_WRITE_ERROR	Cannot write to a scratch file - error from file system. [Error]
SINGLE_FILE_FORMAT	The specified operation is not applicable to CDFs with the single-file format. For example, it does not make sense to close a variable in a single-file CDF. [Informational]
SOME_ALREADY_ALLOCATED	Some of the records being allocated were already allocated. [Informational]
TOO_MANY_PARMS	A type of sparse arrays or compression was encountered having too many parameters. This could be caused by a corrupted CDF or if the CDF was created/modified by a CDF distribution more recent than the one being used. [Error]
TOO_MANY_VARS	A multi-file CDF on a PC may contain only a limited number of variables because of the 8.3 file naming convention of MS-DOS. This consists of 100 rVariables and 100 zVariables. [Error]
UNKNOWN_COMPRESSION	An unknown type of compression was specified or encountered. [Error]
UNKNOWN_SPARSENESS	An unknown type of sparseness was specified or encountered. [Error]
UNSUPPORTED_OPERATION	The attempted operation is not supported at this time. [Error]
VAR_ALREADY_CLOSED	The specified variable is already closed. [Informational]
VAR_CLOSE_ERROR	Error detected while trying to close variable file. Check that sufficient disk space exists for the variable file and that it has not been corrupted. [Error]
VAR_CREATE_ERROR	An error occurred while creating a variable file in a multi-file CDF. Check that a file quota has not been reached. [Error]
VAR_DELETE_ERROR	An error occurred while deleting a variable file in a multi-file CDF. Check that sufficient privilege exist to delete the CDF files. [Error]

VAR_EXISTS	Named variable already exists - cannot create or rename. Each variable in a CDF must have a unique name (rVariables and zVariables can not share names). Note that the CDF library when comparing variable names ignores trailing blanks. [Error]
VAR_NAME_TRUNC	Variable name truncated to CDF_VAR_NAME_LEN256 characters. The variable was created but with a truncated name. [Warning]
VAR_OPEN_ERROR	An error occurred while opening variable file. Check that sufficient privilege exists to open the variable file. Also make sure that the associated variable file exists. [Error]
VAR_READ_ERROR	Failed to read variable as requested - error from file system. Check that the associated file is not corrupted. [Error]
VAR_WRITE_ERROR	Failed to write variable as requested - error from file system. Check that the associated file is not corrupted. [Error]
VIRTUAL_RECORD_DATA	One or more of the records are virtual (never actually written to the CDF). Virtual records do not physically exist in the CDF file(s) but are part of the conceptual view of the data provided by the CDF library. Virtual records are described in the Concepts chapter in the CDF User's Guide. [Informational]

Appendix B

B.1 C#-CDF APIs

The overloaded APIs will have the following **TYPE** symbols, which represent a set of possible types for parameters.

- **TYPE** -- **int*** or “**out int**” for output
- **TYPE2** -- **int*** or “**out int[]**” for output
- **TYPE3** -- **void***, **string**, or **object** for input
- **TYPE4** -- **void***, “**out string**”, or “**out object**” for output
- **TYPE5** -- **void***, **string**, **string[]**, or **object** for input
- **TYPE6** -- **void***, “**out string**”, “**out string[]**” or “**out object**” for output
- **TYPE7** -- **long*** or “**out long**” for output
- **TYPE8** -- **string[]** or **object**

```
int CDFattrCreate (id, attrName, attrScope, attrNum)
void* id; /* in */
string attrName; /* in */
int attrScope; /* in */
TYPE attrNum; /* out */
```

```
int CDFattrEntryInquire (id, attrNum, entryNum, dataType, numElements)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE dataType; /* out */
TYPE numElements; /* out */
```

```
int CDFattrGet (id, attrNum, entryNum, value)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE4 value; /* out */
```

```
int CDFattrInquire (id, attrNum, attrName, attrScope, maxEntry)
void* id; /* in */
int attrNum; /* in */
out string attrName; /* out */
TYPE attrScope; /* out */
TYPE maxEntry; /* out */
```

```
int CDFattrNum (id, attrName)
void* id; /* in */
string attrName; /* in */
```

```

int CDFattrPut (id, attrNum, entryNum, dataType, numElements, value)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
int dataType; /* in */
int numElements; /* in */
TYPE3 value; /* in */

int CDFattrRename (id, attrNum, attrName)
void* id; /* in */
int attrNum; /* in */
string attrName; /* in */

int CDFclose (id)
void* id; /* in */

int CDFcloseCDF (id)
void* id; /* in */

int CDFcloserVar (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFclosezVar (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFconfirmAttrExistence (id, attrName)
void* id; /* in */
string attrName; /* in */

int CDFconfirmEntryExistence (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */

int CDFconfirmrEntryExistence (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */

int CDFconfirmrVarExistence (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFconfirmrVarPadValueExistence (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFconfirmzEntryExistence (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */

int CDFconfirmzVarExistence (id, varNum)
void* id; /* in */

```

```

int    varNum;                                /* in */

int CDFconfirmzVarPadValueExistence (id, varNum)
void*  id;                                    /* in */
int    varNum;                                /* in */

int CDFcreate (CDFname, numDims, dimSizes, encoding, majority, id)
string  CDFname;                              /* in */
int    numDims;                              /* in */
int[]   dimSizes;                             /* in */
int    encoding;                              /* in */
int    majority;                              /* in */
void*   *id;                                  /* out */

int CDFcreateAttr (id, attrName, scope, attrNum)
void*   id;                                    /* in */
string  attrName;                             /* in */
int     scope;                                /* in */
TYPE  attrNum;                              /* out */

int CDFcreateCDF (CDFname, id)
string  CDFname;                              /* in */
void*   *id;                                  /* out */

int CDFcreatorVar (id, varName, dataType, numElements, recVary, dimVarys, varNum)
void*   id;                                    /* in */
string  varName;                              /* in */
int     dataType;                             /* in */
int     numElements;                          /* in */
int     recVary;                              /* in */
int[]   dimVarys;                             /* in */
TYPE  varNum;                              /* out */

int CDFcreatezVar (id, varName, dataType, numElements, numDims, dimSizes, recVary, dimVarys, varNum)
void*   id;                                    /* in */
string  varName;                              /* in */
int     dataType;                             /* in */
int     numElements;                          /* in */
int     numDims;                              /* in */
int[]   dimSizes;                             /* in */
int     recVary;                              /* in */
int[]   dimVarys;                             /* in */
TYPE  varNum;                              /* out */

int CDFdelete (id)
void*   id;                                    /* in */

int CDFdeleteAttr (id, attrNum)
void*   id;                                    /* in */
int     attrNum;                              /* in */

int CDFdeleteAttrgEntry (id, attrNum, entryNum)
void*   id;                                    /* in */
int     attrNum;                              /* in */
int     entryNum;                             /* in */

```



```

int CDFdeleteAttrEntry (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */

int CDFdeleteAttrzEntry (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */

int CDFdeleteCDF (id)
void* id; /* in */

int CDFdeleterVar (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFdeleterVarRecords (id, varNum, startRec, endRec)
void* id; /* in */
int varNum; /* in */
int startRec; /* in */
int endRec; /* in */

int CDFdeleterzVar (id, varNum)
void* id; /* in */
int varNum; /* in */

int CDFdeleterzVarRecords (id, varNum, startRec, endRec)
void* id; /* in */
int varNum; /* in */
int startRec; /* in */
int endRec; /* in */

int CDFdeleterzVarRecordsRenumber (id, varNum, startRec, endRec)
void* id; /* in */
int varNum; /* in */
int startRec; /* in */
int endRec; /* in */

int CDFdoc (id, version, release, text)
void* id; /* in */
TYPE version; /* out */
TYPE release; /* out */
out string text; /* out */

int CDFerror (status, message)
int status; /* in */
out string message; /* out */

int CDFgetAttrEntry (id, attrNum, entryNum, value)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE4 value; /* out */

int CDFgetAttrEntryDataType (id, attrNum, entryNum, dataType)

```

```

void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE dataType; /* out */

int CDFgetAttrgEntryNumElements (id, attrNum, entryNum, numElems)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE numElems; /* out */

int CDFgetAttrMaxgEntry (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
TYPE entryNum; /* out */

int CDFgetAttrMaxrEntry (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
TYPE entryNum; /* out */

int CDFgetAttrMaxzEntry (id, attrNum, entryNum)
void* id; /* in */
int attrNum; /* in */
TYPE entryNum; /* out */

int CDFgetAttrName (id, attrNum, attrName)
void* id; /* in */
int attrNum; /* in */
out string attrName; /* out */

int CDFgetAttrNum (id, attrName) /* out */
void* id; /* in */
string attrName; /* in */

int CDFgetAttrrEntry (id, attrNum, entryNum, value)
void* id; /* in */
int attrNum; /* in */
int entryNum; /* in */
TYPE6 value; /* out */

int CDFgetAttrrEntryDataType (id, attrNum, varNum, dataType)
void* id; /* in */
int attrNum; /* in */
int varNum; /* in */
TYPE dataType; /* out */

int CDFgetAttrrEntryNumElements (id, attrNum, varNum, numElems)
void* id; /* in */
int attrNum; /* in */
int varNum; /* in */
TYPE numElems; /* out */

int CDFgetAttrrEntryNumStrings (id, attrNum, varNum, numStrings)
void* id; /* in */
int attrNum; /* in */

```

```

int    varNum;                                /* in */
TYPE numStrings;                             /* out */

int CDFgetAttrEntryStrings (id, attrNum, varNum, strings)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    varNum;                                /* in */
TYPE8 strings;                              /* out */

int CDFgetAttrScope (id, attrNum, scope)
void*  id;                                    /* in */
int    attrNum;                              /* in */
TYPE  scope;                                /* out */

int CDFgetAttrEntry (id, attrNum, entryNum, value)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    entryNum;                             /* in */
TYPE6 value;                                /* out */

int CDFgetAttrEntryDataType (id, attrNum, varNum, dataType)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    varNum;                                /* in */
TYPE  dataType;                             /* out */

int CDFgetAttrEntryNumElements (id, attrNum, varNum, numElems)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    varNum;                                /* in */
TYPE  numElems;                             /* out */

int CDFgetAttrEntryNumStrings (id, attrNum, varNum, numStrings)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    varNum;                                /* in */
TYPE  numStrings;                           /* out */

int CDFgetAttrEntryStrings (id, attrNum, varNum, strings)
void*  id;                                    /* in */
int    attrNum;                              /* in */
int    varNum;                                /* in */
TYPE8 strings;                              /* out */

int CDFgetCacheSize (id, numBuffers)
void*  id;                                    /* in */
TYPE  numBuffers;                           /* out */

int CDFgetChecksum (id, checksum)
void*  id;                                    /* in */
TYPE  checksum;                             /* out */

int CDFgetCompression (id, compressionType, compressionParms, compressionPercent)
void*  id;                                    /* in */
TYPE  compressionType;                     /* out */
TYPE2 compressionParms;                     /* out */

```

```

TYPE compressionPercent; /* out */

int CDFgetCompressionCacheSize (id, numBuffers)
void* id; /* in */
TYPE numBuffers; /* out */

int CDFgetCompressionInfo (cdfName, compressionType, compressionParms, compressionSize, uncompressionSize)
string cdfName; /* in */
TYPE compressionType; /* out */
TYPE2 compressionParms; /* out */
TYPE7 compressionSize; /* out */
TYPE7 uncompressionSize; /* out */

int CDFgetCopyright (id, copyright)
void* id; /* in */
out string copyright; /* out */

int CDFgetDataTypeSize (dataType, numBytes)
int dataType; /* in */
TYPE numBytes; /* out */

int CDFgetDecoding (id, decoding)
void* id; /* in */
TYPE decoding; /* out */

int CDFgetEncoding (id, encoding)
void* id; /* in */
TYPE encoding; /* out */

int CDFgetFileBackward ()

int CDFgetFormat (id, format)
void* id; /* in */
TYPE format; /* out */

int CDFgetLibraryCopyright (copyright)
out string copyright; /* out */

int CDFgetLibraryVersion (version, release, increment, subIncrement)
TYPE version; /* out */
TYPE release; /* out */
TYPE increment; /* out */
out string subIncrement; /* out */

int CDFgetLeapSecondLastUpdated (id, lastUpdated)
void* id; /* in */
TYPE lastUpdated; /* out */

int CDFgetMajority (id, majority)
void* id; /* in */
TYPE majority; /* out */

int CDFgetMaxWrittenRecNums (id, maxRecrVars, maxReczVars)
void* id; /* in */
TYPE maxRecrVars; /* out */
TYPE maxReczVars; /* out */

```

```

int CDFgetName (id, name)
void* id; /* in */
out string name; /* out */

int CDFgetNegtoPosfp0Mode (id, negtoPosfp0)
void* id; /* in */
TYPE negtoPosfp0; /* out */

int CDFgetNumAttrgEntries (id, attrNum, entries)
void* id; /* in */
int attrNum; /* in */
TYPE entries; /* out */

int CDFgetNumAttributes (id, numAttrs)
void* id; /* in */
TYPE numAttrs; /* out */

int CDFgetNumAttrrEntries (id, attrNum, entries)
void* id; /* in */
int attrNum; /* in */
TYPE entries; /* out */

int CDFgetNumAttrzEntries (id, attrNum, entries)
void* id; /* in */
int attrNum; /* in */
TYPE entries; /* out */

int CDFgetNumgAttributes (id, numAttrs)
void* id; /* in */
TYPE numAttrs; /* out */

int CDFgetNumrVars (id, numVars)
void* id; /* in */
TYPE numrVars; /* out */

int CDFgetNumvAttributes (id, numAttrs)
void* id; /* in */
TYPE numAttrs; /* out */

int CDFgetNumzVars (id, numVars)
void* id; /* in */
TYPE numzVars; /* out */

int CDFgetReadOnlyMode (id, mode)
void* id; /* in */
TYPE mode; /* out */

int CDFgetrVarAllocRecords (id, varNum, allocRecs)
void* id; /* in */
int varNum; /* in */
TYPE allocRecs; /* out */

int CDFgetrVarBlockingFactor (id, varNum, bf)
void* id; /* in */
int varNum; /* in */

```

```

TYPE bf; /* out */

int CDFgetrVarCacheSize (id, varNum, numBuffers)
void* id; /* in */
int varNum; /* in */
TYPE numBuffers; /* out */

int CDFgetrVarCompression (id, varNum, cType, cParms, cPercent)
void* id; /* in */
int varNum; /* in */
TYPE cType; /* out */
TYPE2 cParms; /* out */
TYPE cPercent; /* out */

int CDFgetrVarData (id, varNum, recNum, indices, value)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */
TYPE4 value; /* out */

int CDFgetrVarDataType (id, varNum, dataType)
void* id; /* in */
int varNum; /* in */
TYPE dataType; /* out */

int CDFgetrVarsDimSizes (id, varNum, dimSizes)
void* id; /* in */
int varNum; /* in */
TYPE2 dimSizes; /* out */

int CDFgetrVarDimVariances (id, varNum, dimVarys)
void* id; /* in */
int varNum; /* in */
TYPE2 dimVarys; /* out */

int CDFgetrVarInfo (id, varNum, dataType, numElems, numDims, dimSizes)
void* id; /* in */
int varNum; /* in */
TYPE dataType; /* out */
TYPE numElems; /* out */
TYPE numDims; /* out */
TYPE2 dimSizes; /* out */

int CDFgetrVarMaxAllocRecNum (id, varNum, maxRec)
void* id; /* in */
int varNum; /* in */
TYPE maxRec; /* out */

int CDFgetrVarMaxWrittenRecNum (id, varNum, maxRec)
void* id; /* in */
int varNum; /* in */
TYPE maxRec; /* out */

int CDFgetrVarName (id, varNum, varName)
void* id; /* in */

```

```

int    varNum;                /* in */
out string    varName;      /* out */

int CDFgetrVarsNumDims (id, varNum, numDims)
void* id;                    /* in */
int    varNum;              /* in */
TYPE numDims;             /* out */

int CDFgetrVarNumElements (id, varNum, numElems)
void* id;                    /* in */
int    varNum;              /* in */
TYPE numElems;           /* out */

int CDFgetrVarNumRecsWritten (id, varNum, numRecs)
void* id;                    /* in */
int    varNum;              /* in */
TYPE numRecs;           /* out */

int CDFgetrVarPadValue (id, varNum, padValue)
void* id;                    /* in */
int    varNum;              /* in */
TYPE4 padValue;         /* out */

int CDFgetrVarRecordData (id, varNum, recNum, buffer)
void* id;                    /* in */
int    varNum;              /* in */
int    recNum;              /* in */
TYPE6 buffer;           /* out */

int CDFgetrVarRecVariance (id, varNum, recVary)
void* id;                    /* in */
int    varNum;              /* in */
TYPE recVary;           /* out */

int CDFgetrVarReservePercent (id, varNum, percent)
void* id;                    /* in */
int    varNum;              /* in */
TYPE percent;          /* out */

int CDFgetrVarsDimSizes (id, dimSizes)
void* id;                    /* in */
TYPE2 dimSizes;        /* out */

int CDFgetrVarSeqData (id, varNum, value)
void* id;                    /* in */
int    varNum;              /* in */
TYPE4 value;           /* out */

int CDFgetrVarSeqPos (id, varNum, recNum, indices)
void* id;                    /* in */
int    varNum;              /* in */
TYPE recNum;           /* out */
TYPE2 indices;         /* out */

int CDFgetrVarsMaxWrittenRecNum (id, recNum)
void* id;                    /* in */

```

```

TYPE  recNum;                                /* out */

int CDFgetrVarsNumDims (id, numDims)
void*  id;                                     /* in */
TYPE  numDims;                               /* out */

int CDFgetrVarSparseRecords (id, varNum, sRecords)
void*  id;                                     /* in */
int    varNum;                                 /* in */
TYPE  sRecords;                              /* out */

int CDFgetStageCacheSize (id, numBuffers)
void*  id;                                     /* in */
TYPE  numBuffers;                            /* out */

int CDFgetStatusText (status, text)
int status;                                    /* in */
out string      text;                          /* out */

int CDFgetValidate ()

int CDFgetVarNum (id, varName)
void*  id;                                     /* in */
string varName;                               /* in */

int CDFgetVersion (id, version, release, increment)
void*  id;                                     /* in */
TYPE  version;                               /* out */
TYPE  release;                               /* out */
TYPE  increment;                            /* out */

int CDFgetzMode (id, zMode)
void*  id;                                     /* in */
TYPE  zMode;                                /* out */

int CDFgetzVarAllocRecords (id, varNum, allocRecs)
void*  id;                                     /* in */
int    varNum;                                 /* in */
TYPE  allocRecs;                            /* out */

int CDFgetzVarBlockingFactor (id, varNum, bf)
void*  id;                                     /* in */
int    varNum;                                 /* in */
TYPE  bf;                                   /* out */

int CDFgetzVarCacheSize (id, varNum, numBuffers)
void*  id;                                     /* in */
int    varNum;                                 /* in */
TYPE  numBuffers;                            /* out */

int CDFgetzVarCompression (id, varNum, cType, cParms, cPercent)
void*  id;                                     /* in */
int    varNum;                                 /* in */
TYPE  cType;                                 /* out */
TYPE2 cParms;                                /* out */
TYPE  cPercent;                              /* out */

```



```

int CDFgetzVarData (id, varNum, recNum, indices, value)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */
TYPE4 value; /* out */

int CDFgetzVarDataType (id, varNum, dataType)
void* id; /* in */
int varNum; /* in */
TYPE dataType; /* out */

int CDFgetzVarDimSizes (id, varNum, dimSizes)
void* id; /* in */
int varNum; /* in */
TYPE2 dimSizes; /* out */

int CDFgetzVarDimVariances (id, varNum, dimVarys)
void* id; /* in */
int varNum; /* in */
TYPE2 dimVarys; /* out */

int CDFgetzVarInfo (id, varNum, dataType, numElems, numDims, dimSizes)
void* id; /* in */
int varNum; /* in */
TYPE dataType; /* out */
TYPE numElems; /* out */
TYPE numDims; /* out */
TYPE2 dimSizes; /* out */

int CDFgetzVarMaxAllocRecNum (id, varNum, maxRec)
void* id; /* in */
int varNum; /* in */
TYPE maxRec; /* out */

int CDFgetzVarMaxWrittenRecNum (id, varNum, maxRec)
void* id; /* in */
int varNum; /* in */
TYPE maxRec; /* out */

int CDFgetzVarName (id, varNum, varName)
void* id; /* in */
int varNum; /* in */
out string varName; /* out */

int CDFgetzVarNumDims (id, varNum, numDims)
void* id; /* in */
int varNum; /* in */
TYPE numDims; /* out */

int CDFgetzVarNumElements (id, varNum, numElems)
void* id; /* in */
int varNum; /* in */
TYPE numElems; /* out */

```

```

int CDFgetzVarNumRecsWritten (id, varNum, numRecs)
void* id; /* in */
int varNum; /* in */
TYPE numRecs; /* out */

int CDFgetzVarPadValue (id, varNum, padValue)
void* id; /* in */
int varNum; /* in */
TYPE4 padValue; /* out */

int CDFgetzVarRecordData (id, varNum, recNum, buffer)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
TYPE6 buffer; /* out */

int CDFgetzVarRecVariance (id, varNum, recVary)
void* id; /* in */
int varNum; /* in */
TYPE recVary; /* out */

int CDFgetzVarReservePercent (id, varNum, percent)
void* id; /* in */
int varNum; /* in */
TYPE percent; /* out */

int CDFgetzVarSeqData (id, varNum, value)
void* id; /* in */
int varNum; /* in */
TYPE4 value; /* out */

int CDFgetzVarSeqPos (id, varNum, recNum, indices)
void* id; /* in */
int varNum; /* in */
TYPE recNum; /* out */
TYPE2 indices; /* out */

int CDFgetzVarsMaxWrittenRecNum (id, recNum)
void* id; /* in */
TYPE recNum; /* out */

int CDFgetzVarSparseRecords (id, varNum, sRecords)
void* id; /* in */
int varNum; /* in */
TYPE sRecords; /* out */

int CDFhyperGetzVarData (id, varNum, recNum, recCount, recInterval, indices, counts, intervals, buffer)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int recCount; /* in */
int recInterval; /* in */
int[] indices; /* in */
int[] counts; /* in */
int[] intervals; /* in */
TYPE6 buffer; /* out */

```

```

int CDFhyperGetzVarData (id, varNum, recNum, recCount, recInterval, indices, counts, intervals, buffer)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int recCount; /* in */
int recInterval; /* in */
int[] indices; /* in */
int[] counts; /* in */
int[] intervals; /* in */
TYPE6 buffer; /* out */

```

```

int CDFhyperPutrVarData (id, varNum, recNum, recCount, recInterval, indices, counts, intervals, buffer)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int recCount; /* in */
int recInterval; /* in */
int[] indices; /* in */
int[] counts; /* in */
int[] intervals; /* in */
TYPE5 buffer; /* in */

```

```

int CDFhyperPutzVarData (id, varNum, recNum, recCount, recInterval, indices, counts, intervals, buffer)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int recCount; /* in */
int recInterval; /* in */
int[] indices; /* in */
int[] counts; /* in */
int[] intervals; /* in */
TYPE5 buffer; /* in */

```

```

int CDFinquire (id, numDims, dimSizes, encoding, majority, maxRec, numVars, numAttrs)
void* id; /* in */
TYPE numDims; /* out */
TYPE2 dimSizes; /* out */
TYPE encoding; /* out */
TYPE majority; /* out */
TYPE maxRec; /* out */
TYPE numVars; /* out */
TYPE numAttrs; /* out */

```

```

int CDFinquireAttr (id, attrNum, attrName, attrScope, maxgEntry, maxrEntry, maxxEntry)
void* id; /* in */
int attrNum; /* in */
out string attrName; /* out */
TYPE attrScope; /* out */
TYPE maxgEntry; /* out */
TYPE maxrEntry; /* out */
TYPE maxxEntry; /* out */

```

```

int CDFinquireAttrgEntry (id, attrNum, entryNum, dataType, numElems)
void* id; /* in */
int attrNum; /* in */

```

```

int    entryNum;                /* in */
TYPE dataType;                /* out */
TYPE numElems;                /* out */

int CDFinquireAttrEntry (id, attrNum, entryNum, dataType, numElems)
void*  id;                      /* in */
int    attrNum;                 /* in */
int    entryNum;               /* in */
TYPE dataType;                /* out */
TYPE numElems;                /* out */

int CDFinquireAttrzEntry (id, attrNum, entryNum, dataType, numElems)
void*  id;                      /* in */
int    attrNum;                 /* in */
int    entryNum;               /* in */
TYPE dataType;                /* out */
TYPE numElems;                /* out */

int CDFinquireCDF (id, numDims, dimSizes, encoding, majority, maxrRec, numrVars, maxzRec,
                  numzVars, numAttrs)
void*  id;                      /* in */
TYPE numDims;                /* out */
TYPE2 dimSizes;              /* out */
TYPE encoding;                /* out */
TYPE majority;                /* out */
TYPE maxrRec;                 /* out */
TYPE numrVars;                /* out */
TYPE maxzRec;                 /* out */
TYPE numzVars;                /* out */
TYPE numAttrs;                /* out */

int CDFinquirerVar (id, varNum, varName, dataType, numElems, numDims, dimSizes, recVary, dimVarys)
void*  id;                      /* in */
int    varNum;                 /* in */
out string    varName;         /* out */
TYPE dataType;                /* out */
TYPE numElems;                /* out */
TYPE numDims;                /* out */
TYPE2 dimSizes;              /* out */
TYPE recVary;                /* out */
TYPE2 dimVarys;              /* out */

int CDFinquirezVar (id, varNum, varName, dataType, numElems, numDims, dimSizes, recVary, dimVarys)
void*  id;                      /* in */
int    varNum;                 /* in */
out string    varName;         /* out */
TYPE dataType;                /* out */
TYPE numElems;                /* out */
TYPE numDims;                /* out */
TYPE2 dimSizes;              /* out */
TYPE recVary;                /* out */
TYPE2 dimVarys;              /* out */

int CDFopen (CDFname, id)
string  CDFname;                /* in */
void*  *id;                      /* out */

```

```

int CDFopenCDF (CDFname, id)
string  CDFname;           /* in */
void*   *id;               /* out */

int CDFselectCDF (id)
void*   id;                /* in */

int CDFputAttrEntry (id, attrNum, entryNum, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
string value;             /* in */

int CDFputAttrEntry (id, attrNum, entryNum, dataType, numElems, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
int     dataType;          /* in */
int     numElems;          /* in */
TYPE3 value;             /* in */

int CDFputAttrEntry (id, attrNum, entryNum, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
string value;             /* in */

int CDFputAttrEntry (id, attrNum, entryNum, dataType, numElems, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
int     dataType;          /* in */
int     numElems;          /* in */
TYPE3 value;             /* in */

int CDFputAttrEntryStrings (id, attrNum, strings)
void*   id;                /* in */
int     attrNum;           /* in */
TYPE8 strings;           /* in */

int CDFputAttrEntry (id, attrNum, entryNum, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
string value;             /* in */

int CDFputAttrEntry (id, attrNum, entryNum, dataType, numElems, value)
void*   id;                /* in */
int     attrNum;           /* in */
int     entryNum;          /* in */
int     dataType;          /* in */
int     numElems;          /* in */
TYPE3 value;             /* in */

int CDFputAttrEntryStrings (id, attrNum, strings)

```

```

void* id; /* in */
int attrNum; /* in */
TYPE8 strings; /* in */

int CDFputrVarData (id, varNum, recNum, indices, value)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */
TYPE3 value; /* in */

int CDFputrVarPadValue (id, varNum, padValue)
void* id; /* in */
int varNum; /* in */
TYPE3 padValue; /* in */

int CDFputrVarRecordData (id, varNum, recNum, values)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
TYPE5 values; /* in */

int CDFputrVarSeqData (id, varNum, value)
void* id; /* in */
int varNum; /* in */
TYPE3 value; /* in */

int CDFputzVarData (id, varNum, recNum, indices, value)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */
TYPE3 value; /* in */

int CDFputzVarPadValue (id, varNum, padValue)
void* id; /* in */
int varNum; /* in */
TYPE3 padValue; /* in */

int CDFputzVarRecordData (id, varNum, recNum, values)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
TYPE5 values; /* in */

int CDFputzVarSeqData (id, varNum, value)
void* id; /* in */
int varNum; /* in */
TYPE3 value; /* in */

int CDFrenameAttr (id, attrNum, attrName)
void* id; /* in */
int attrNum; /* in */
string attrName; /* in */

int CDFrenamerVar (id, varNum, varName)

```

```

void*   id;                               /* in */
int     varNum;                            /* in */
string  varName;                           /* in */

int CDFrenamezVar (id, varNum, varName)
void*   id;                               /* in */
int     varNum;                            /* in */
string  varName;                           /* in */

int CDFselect (id)
void*   id;                               /* in */

int CDFselectCDF (id)
void*   id;                               /* in */

int CDFsetAttrEntryDataSpec (id, attrNum, entryNum, dataType)
void*   id;                               /* in */
int     attrNum;                           /* in */
int     entryNum;                          /* in */
int     dataType;                          /* in */

int CDFsetAttrEntryDataSpec (id, attrNum, entryNum, dataType)
void*   id;                               /* in */
int     attrNum;                           /* in */
int     entryNum;                          /* in */
int     dataType;                          /* in */

int CDFsetAttrScope (id, attrNum, scope)
void*   id;                               /* in */
int     attrNum;                           /* in */
int     scope;                             /* in */

int CDFsetAttrzEntryDataSpec (id, attrNum, entryNum, dataType)
void*   id;                               /* in */
int     attrNum;                           /* in */
int     entryNum;                          /* in */
int     dataType;                          /* in */

int CDFsetCacheSize (id, numBuffers)
void*   id;                               /* in */
int     numBuffers;                        /* in */

int CDFsetChecksum (id, checksum)
void*   id;                               /* in */
int     checksum;                          /* in */

int CDFsetCompression (id, compressionType, compressionParms)
void*   id;                               /* in */
int     compressionType;                  /* in */
int[]   compressionParms;                 /* in */

int CDFsetCompressionCacheSize (id, numBuffers)
void*   id;                               /* in */
int     numBuffers;                        /* in */

int CDFsetDecoding (id, decoding)

```

```

void* id; /* in */
int decoding; /* in */

int CDFsetEncoding (id, encoding)
void* id; /* in */
int encoding; /* in */

void CDFsetFileBackward (mode)
int mode; /* in */

int CDFsetFormat (id, format)
void* id; /* in */
int format; /* in */

int CDFsetLeapSecondLastUpdated (id, lastUpdated)
void* id; /* in */
int lastUpdated; /* in */

int CDFsetMajority (id, majority)
void* id; /* in */
int majority; /* in */

int CDFsetNegtoPosfp0Mode (id, negtoPosfp0)
void* id; /* in */
int negtoPosfp0; /* in */

int CDFsetReadOnlyMode (id, readOnly)
void* id; /* in */
int readOnly; /* in */

int CDFsetrVarAllocBlockRecords (id, varNum, firstRec, lastRec)
void* id; /* in */
int varNum; /* in */
int firstRec; /* in */
int lastRec; /* in */

int CDFsetrVarAllocRecords (id, varNum, numRecs)
void* id; /* in */
int varNum; /* in */
int numRecs; /* in */

int CDFsetrVarBlockingFactor (id, varNum, bf)
void* id; /* in */
int varNum; /* in */
int bf; /* in */

int CDFsetrVarCacheSize (id, varNum, numBuffers)
void* id; /* in */
int varNum; /* in */
int numBuffers; /* in */

int CDFsetrVarCompression (id, varNum, compressionType, compressionParms)
void* id; /* in */
int varNum; /* in */
int compressionType; /* in */
int[] compressionParms; /* in */

```



```

int CDFsetrVarDataSpec (id, varNum, dataType)
void* id; /* in */
int varNum; /* in */
int dataType; /* in */

int CDFsetrVarDimVariances (id, varNum, dimVarys)
void* id; /* in */
int varNum; /* in */
int[] dimVarys; /* in */

int CDFsetrVarInitialRecs (id, varNum, initialRecs)
void* id; /* in */
int varNum; /* in */
int initialRecs; /* in */

int CDFsetrVarRecVariance (id, varNum, recVary)
void* id; /* in */
int varNum; /* in */
int recVary; /* in */

int CDFsetrVarReservePercent (id, varNum, reservePercent)
void* id; /* in */
int varNum; /* in */
int reservePercent; /* in */

int CDFsetrVarsCacheSize (id, numBuffers)
void* id; /* in */
int numBuffers; /* in */

int CDFsetrVarSeqPos (id, varNum, recNum, indices)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */

int CDFsetrVarSparseRecords (id, varNum, sRecords)
void* id; /* in */
int varNum; /* in */
int sRecords; /* in */

int CDFsetStageCacheSize (id, numBuffers)
void* id; /* in */
int numBuffers; /* in */

void CDFsetValidate (mode)
int mode; /* in */

int CDFsetzMode (id, zMode)
void* id; /* in */
int zMode; /* in */

int CDFsetzVarAllocBlockRecords (id, varNum, firstRec, lastRec)
void* id; /* in */
int varNum; /* in */
int firstRec; /* in */

```

```

int      lastRec;                                /* in */

int CDFsetzVarAllocRecords (id, varNum, numRecs)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     numRecs;                               /* in */

int CDFsetzVarBlockingFactor (id, varNum, bf)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     bf;                                    /* in */

int CDFsetzVarCacheSize (id, varNum, numBuffers)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     numBuffers;                            /* in */

int CDFsetzVarCompression (id, varNum, compressionType, compressionParms)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     compressionType;                       /* in */
int[]   compressionParms;                      /* in */

int CDFsetzVarDataSpec (id, varNum, dataType)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     dataType;                              /* in */

int CDFsetzVarDimVariances (id, varNum, dimVarys)
void*   id;                                    /* in */
int     varNum;                                /* in */
int[]   dimVarys;                              /* in */

int CDFsetzVarInitialRecs (id, varNum, initialRecs)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     initialRecs;                           /* in */

int CDFsetzVarRecVariance (id, varNum, recVary)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     recVary;                               /* in */

int CDFsetzVarReservePercent (id, varNum, reservePercent)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     reservePercent;                        /* in */

int CDFsetzVarsCacheSize (id, numBuffers)
void*   id;                                    /* in */
int     numBuffers;                            /* in */

int CDFsetzVarSeqPos (id, varNum, recNum, indices)
void*   id;                                    /* in */
int     varNum;                                /* in */
int     recNum;                                /* in */

```

```

int[]    indices;                                /* in */

int CDFsetzVarSparseRecords (id, varNum, sRecords)
void*    id;                                    /* in */
int      varNum;                                /* in */
int      sRecords;                              /* in */

int CDFvarClose (id, varNum)
void*    id;                                    /* in */
int      varNum;                                /* in */

int CDFvarCreate (id, varName, dataType, numElements, recVariance, dimVariances, varNum)
void*    id;                                    /* in */
string   varName;                               /* in */
int      dataType;                              /* in */
int      numElements;                           /* in */
int      recVariance;                           /* in */
int[]    dimVariances;                          /* in */
TYPE     varNum;                                /* out */

int CDFvarGet (id, varNum, recNum, indices, value)
void*    id;                                    /* in */
int      varNum;                                /* in */
int      recNum;                                /* in */
int[]    indices;                               /* in */
TYPE4 value;                                   /* out */

int CDFvarHyperGet (id, varNum, recStart, recCount, recInterval, indices, counts, intervals, buffer)
void*    id;                                    /* in */
int      varNum;                                /* in */
int      recStart;                              /* in */
int      recCount;                              /* in */
int      recInterval;                           /* in */
int[]    indices;                               /* in */
int[]    counts;                                /* in */
int[]    intervals;                             /* in */
TYPE6 buffer;                                 /* out */

int CDFvarHyperPut (id, varNum, recStart, recCount, recInterval, indices, counts, intervals, buffer)
void*    id;                                    /* in */
int      varNum;                                /* in */
int      recStart;                              /* in */
int      recCount;                              /* in */
int      recInterval;                           /* in */
int[]    indices;                               /* in */
int[]    counts;                                /* in */
int[]    intervals;                             /* in */
TYPE3 buffer;                                 /* in */

int CDFvarInquire (id, varNum, varName, dataType, numElements, recVariance, dimVariances)
void*    id;                                    /* in */
int      varNum;                                /* in */
out string    varName;                          /* out */
TYPE dataType;                               /* out */
TYPE numElements;                            /* out */
TYPE recVariance;                             /* out */

```

```
TYPE2 dimVariances; /* out */

int CDFvarNum (id, varName)
void* id; /* in */
string varName; /* in */

int CDFvarPut (id, varNum, recNum, indices, value)
void* id; /* in */
int varNum; /* in */
int recNum; /* in */
int[] indices; /* in */
TYPE3 value; /* in */

int CDFvarRename (id, varNum, varName)
void* id; /* in */
int varNum; /* in */
string varName; /* in */
```


B.2 EPOCH Utility Methods

The overloaded APIs will have the following **TYPE** symbols, which represent a set of possible types for parameters.

- **TYPE** -- **int*** or “**out int**”
- **TYPE2** -- **double*** or “**out double[]**”
- **TYPE3** -- **double** or **long**
- **TYPE4** -- **double*** or **long***

```
double computeEPOCH (year, month, day, hour, minute, second, msec)
int year; /* in */
int month; /* in */
int day; /* in */
int hour; /* in */
int minute; /* in */
int second; /* in */
int msec; /* in */
```

```
double[] computeEPOCH (year, month, day, hour, minute, second, msec)
int[] year; /* in */
int[] month; /* in */
int[] day; /* in */
int[] hour; /* in */
int[] minute; /* in */
int[] second; /* in */
int[] msec; /* in */
```

```
void EPOCHbreakdown (epoch, year, month, day, hour, minute, second, msec)
double epoch; /* in */
TYPE year; /* out */
TYPE month; /* out */
TYPE day; /* out */
TYPE hour; /* out */
TYPE minute; /* out */
TYPE second; /* out */
TYPE msec; /* out */
```

```
void EPOCHbreakdown (epoch, year, month, day, hour, minute, second, msec)
double[] epoch; /* in */
out int[] year; /* out */
out int[] month; /* out */
out int[] day; /* out */
out int[] hour; /* out */
out int[] minute; /* out */
out int[] second; /* out */
out int[] msec; /* out */
```

```
string toEncodeEPOCH (epoch)
double epoch; /* in */
```

```
string toEncodeEPOCH (epoch, style)
double epoch; /* in */
int style; /* in */
```



```

string[] toEncodeEPOCH (epoch)
double[] epoch;
/* in */

string[] toEncodeEPOCH (epoch, style)
double[] epoch;
int style;
/* in */
/* in */

void encodeEPOCH (epoch, epString)
double epoch;
out string epString;
/* in */
/* out */

void encodeEPOCH (epoch, epString)
double[] epoch;
out string[] epString;
/* in */
/* out */

void encodeEPOCH1 (epoch, epString)
double epoch;
out string epString;
/* in */
/* out */

void encodeEPOCH2 (epoch, epString)
double epoch;
out string epString;
/* in */
/* out */

void encodeEPOCH3 (epoch, epString)
double epoch;
out string epString;
/* in */
/* out */

void encodeEPOCH4 (epoch, epString)
double epoch;
out string epString;
/* in */
/* out */

void encodeEPOCHx (epoch, format, epString)
double epoch;
string format;
out string epString;
/* in */
/* in */
/* out */

double toParseEPOCH (epString)
string epString;
/* in */

double[] toParseEPOCH (epString)
string[] epString;
/* in */

double parseEPOCH (epString)
string epString;
/* in */

double[] parseEPOCH (epString)
string[] epString;
/* in */

double parseEPOCH1 (epString)
string epString;
/* in */

double parseEPOCH2 (epString)
string epString;
/* in */

double parseEPOCH3 (epString)

```

```

string epString; /* in */

double parseEPOCH4 (epString)
string epString; /* in */

double computeEPOCH16 (year, month, day, hour, minute, second, msec, microsec, nanosec, picosec)
int year; /* in */
int month; /* in */
int day; /* in */
int hour; /* in */
int minute; /* in */
int second; /* in */
int msec; /* in */
int microsec; /* in */
int nanosec; /* in */
int picosec; /* in */
TYPE2 epoch; /* out */

void EPOCH16breakdown (epoch, year, month, day, hour, minute, second, msec, microsec, nanosec, picosec)
double[] epoch; /* in */
TYPE year; /* out */
TYPE month; /* out */
TYPE day; /* out */
TYPE hour; /* out */
TYPE minute; /* out */
TYPE second; /* out */
TYPE msec; /* out */
TYPE microsec; /* out */
TYPE nanosec; /* out */
TYPE picosec; /* out */

string toEncodeEPOCH16 (epoch)
double[] epoch; /* in */

string toEncodeEPOCH16 (epoch, style)
double[] epoch; /* in */
int style; /* in */

void encodeEPOCH16 (epoch, epString)
double[] epoch; /* in */
out string epString; /* out */

void encodeEPOCH16_1 (epoch, epString)
double[] epoch; /* in */
out string epString; /* out */

void encodeEPOCH16_2 (epoch, epString)
double[] epoch; /* in */
out string epString; /* out */

void encodeEPOCH16_3 (epoch, epString)
double[] epoch; /* in */
out string epString; /* out */

void encodeEPOCH16_4 (epoch, epString)
double[] epoch; /* in */

```

```

out string epString; /* out */

void encodeEPOCH16_x (epoch, format, epString)
double[] epoch; /* in */
string format; /* in */
out string epString; /* out */

double[] toParseEPOCH16 (epString)
string epString; /* in */

double parseEPOCH16 (epString, epoch)
string epString; /* in */
TYPE2 epoch; /* out */

double parseEPOCH16_1 (epString)
string epString; /* in */
TYPE2 epoch; /* out */

double parseEPOCH16_2 (epString)
string epString; /* in */
TYPE2 epoch; /* out */

double parseEPOCH16_3 (epString)
string epString; /* in */
TYPE2 epoch; /* out */

double parseEPOCH16_4 (epString)
string epString; /* in */
TYPE2 epoch; /* out */

long computeTT2000 (year, month, day)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */

long[] computeTT2000 (year, month, day)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */

long computeTT2000 (year, month, day, hour)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */
TYPE3 hour; /* in */

long[] computeTT2000 (year, month, day, hour)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */

long computeTT2000 (year, month, day, hour, minute)
TYPE3 year; /* in */
TYPE3 month; /* in */

```

```
TYPE3 day; /* in */
TYPE3 hour; /* in */
TYPE3 minute; /* in */
```

```
long[] computeTT2000 (year, month, day, hour, minute)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */
double[] minute; /* in */
```

```
long computeTT2000 (year, month, day, hour, minute, second)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */
TYPE3 hour; /* in */
TYPE3 minute; /* in */
TYPE3 second; /* in */
```

```
long[] computeTT2000 (year, month, day, hour, minute, second)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */
double[] minute; /* in */
double[] second; /* in */
```

```
long computeTT2000 (year, month, day, hour, minute, second, msec)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */
TYPE3 hour; /* in */
TYPE3 minute; /* in */
TYPE3 second; /* in */
TYPE3 msec; /* in */
```

```
long[] computeTT2000 (year, month, day, hour, minute, second, msec)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */
double[] minute; /* in */
double[] second; /* in */
double[] msec; /* in */
```

```
long computeTT2000 (year, month, day, hour, minute, second, msec, usec)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */
TYPE3 hour; /* in */
TYPE3 minute; /* in */
TYPE3 second; /* in */
TYPE3 msec; /* in */
TYPE3 usec; /* in */
```

```
long[] computeTT2000 (year, month, day, hour, minute, second, msec, usec)
```

```
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */
double[] minute; /* in */
double[] second; /* in */
double[] msec; /* in */
double[] usec; /* in */
```

```
long computeTT2000 (year, month, day, hour, minute, second, msec, usec, nsec)
TYPE3 year; /* in */
TYPE3 month; /* in */
TYPE3 day; /* in */
TYPE3 hour; /* in */
TYPE3 minute; /* in */
TYPE3 second; /* in */
TYPE3 msec; /* in */
TYPE3 usec; /* in */
TYPE3 nsec; /* in */
```

```
long[] computeTT2000 (year, month, day, hour, minute, second, msec, usec, nsec)
double[] year; /* in */
double[] month; /* in */
double[] day; /* in */
double[] hour; /* in */
double[] minute; /* in */
double[] second; /* in */
double[] msec; /* in */
double[] usec; /* in */
double[] nsec; /* in */
```

```
void TT2000breakdown (epoch, year, month, day, hour, minute, second, msec, usec, nsec)
long epoch; /* in */
out TYPE4 year; /* out */
out TYPE4 month; /* out */
out TYPE4 day; /* out */
out TYPE4 hour; /* out */
out TYPE4 minute; /* out */
out TYPE4 second; /* out */
out TYPE4 msec; /* out */
out TYPE4 usec; /* out */
out TYPE4 nsec; /* out */
```

```
void TT2000breakdown (epoch, year, month, day, hour, minute, second, msec, usec, nsec)
long[] epoch; /* in */
out double[] year; /* out */
out double[] month; /* out */
out double[] day; /* out */
out double[] hour; /* out */
out double[] minute; /* out */
out double[] second; /* out */
out double[] msec; /* out */
out double[] usec; /* out */
out double[] nsec; /* out */
```

```
string toEncodeTT2000 (epoch)
```

```

long epoch; /* in */

string toEncodeTT2000 (epoch, style)
long epoch; /* in */
int style; /* in */

string[] toEncodeTT2000 (epoch)
long[] epoch; /* in */

string[] toEncodeTT2000 (epoch, style)
long[] epoch; /* in */
int style; /* in */

void encodeTT2000 (epoch, epString, style)
long epoch; /* in */
out string epString; /* out */
int style; /* in */

void encodeTT2000 (epoch, epString, style)
long[] epoch; /* in */
out string[] epString; /* out */
int style; /* in */

long toParseTT2000 (epString)
string epString; /* in */

long[] toParseTT2000 (epString)
string[] epString; /* in */

long parseTT2000 (epString)
string epString; /* in */

long[] parseTT2000 (epString)
string[] epString; /* in */

void CDFgetLastDateinLeapSecondsTable (year, month, day)
out int year; /* out */
out int month; /* out */
out int day; /* out */

double EPOCHtoUnixTime (epoch)
double epoch; /* in */

double[] EPOCHtoUnixTime (epochs)
double[] epochs; /* in */

double EPOCH16toUnixTime (epoch)
double[] epoch; /* in */

double TT2000toUnixTime (epoch)
long epoch; /* in */

double[] TT2000toUnixTime (epochs)
long[] epochs; /* in */

double UnixTimetoEPOCH (unixTime)

```

```
double unixTime; /* in */
```

```
double[] UnixTimetoEPOCH (unixTimes) /* in */  
double[] unixTimes;
```

```
double[] UnixTimetoEPOCH16 (unixTime) /* in */  
double unixTime;
```

```
long UnixTimetoTT2000 (unixTime) /* in */  
double unixTime;
```

```
long[] UnixTimetoTT2000 (unixTimes) /* in */  
double[] unixTimes;
```

B.3 CDF Utility Methods

```
bool CDFFileExists (fileName)                                     /* in */
string fileName;

int CDFgetChecksumValue(checksum)                               /* in */
string fileName;

int CDFgetCompressionTypeValue(compressionType)               /* in */
string compressionType;

int CDFgetDataTypeValue(dataType)                              /* in */
string dataType;

int CDFgetDecodingValue(decoding)                              /* in */
string decoding;

int CDFgetEncodingValue(encoding)                              /* in */
string encoding;

int CDFgetFormatValue(format)                                  /* in */
string format;

int CDFgetMajorityValue(majority)                              /* in */
string majority;

int CDFgetSparseRecordValue(sparseRecord)                     /* in */
string sparseRecord;

string CDFgetStringChecksum(checksum)                           /* in */
int checksum;

string CDFgetStringCompressionType(compressionType)           /* in */
int compressionType;

string CDFgetStringDataType(dataType)                          /* in */
int dataType;

string CDFgetStringDecoding(decoding)                          /* in */
int decoding;

string CDFgetStringEncoding(encoding)                          /* in */
int encoding;

string CDFgetStringFormat(format)                              /* in */
int format;

string CDFgetStringMajority(majority)                          /* in */
int majority;

string CDFgetStringSparseRecord(sparseRecord)                 /* in */
int sparseRecord;
```


B.4 CDF Exception Methods

```
int CDFgetCurrentStatus ()
```

```
string CDFgetStatusMsg(status)  
int status;
```

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