RFC: Reference Manual Entries for VDS functions

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This document proposes *HDF5 Reference Manual* (RM) entries for the creation functions that support the Virtual Dataset (VDS) feature in HDF5.

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# Introduction

As we develop the VDS feature, we will be adding new public functions to the library. This document summarizes RM entries for the new functions. Each section of the document corresponds to a specific VDS function.

We used the same style for API names, parameters, and return values as for the existing functions with similar functionality such as H5Pset\_external, H5Pset\_external\_count, and H5Iget\_name.

The document will evolve during the lifespan of the project. It will be updated each time the team starts working on new VDS functionality. The document will be shared with the members of the VDS development team and major stakeholders to get feedback on the APIs as early as possible. The document is under SVN control <http://svn.hdfgroup.uiuc.edu/hdf5doc/trunk/RFCs/HDF5_Library/VirtualDataset/>.

When checking the new version, update the name of the document and change page headers to reflect new version number and new date.

# VDS APIs

## VDS Creation

### Modifications to H5Pset\_layout and H5Pget\_layout

We should update the documentation for H5Pset(get)\_layout to add the new H5D\_VIRTUAL layout.

### H5Pset\_virtual

**Name:** H5Pset\_virtual

**Signature:**

*herr\_t* H5Pset\_virtual (*hid\_t* dcpl\_id, *hid\_t* vspace\_id, *const char \** src\_file\_name, *const char \** src\_dset\_name, *hid\_t* src\_space\_id )

**Purpose:**

Sets the mapping between the virtual and source datasets.

**Description:**

H5Pset\_virtual maps elements of the virtual dataset described by the virtual dataspace identifier vspace\_id to the elements of the source dataset described by the source dataset dataspace identifier src\_space\_id. The source dataset is identified by the name of the file where it is located, src\_file\_name, and the name of the dataset, src\_dset\_name.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the dataset creation property list that will be used when creating the virtual dataset. |
| *hid\_t* vspace\_id | *-* | IN: The dataspace identifier with the selection within the virtual dataset applied, possibly an unlimited selection. |
| *const char \** src\_file\_name | *-* | IN: The name of the HDF5 file where the source dataset is located. The file might not exist yet. The name can be specified using a C-style printf statement as described below. |
| *const char \** src\_dset\_name | *-* | IN: The path to the HDF5 dataset in the file specified by src\_file\_name. The dataset might not exist yet. The dataset name can be specified using a C-style printf statement as described below. |
| *hid\_t* src\_space\_id | *-* | IN: The source dataset’s dataspace identifier with a selection applied, possibly an unlimited selection. |

When a selection with unlimited dimensions is used for the source dataset, the selection in the virtual dataset must also be an unlimited selection with the same number of unlimited dimensions. If fixed-size selections are used, the number of elements in the source dataset selection must be the same as the number of elements in the virtual dataset selection.

**C-style printf Formatting No****tes**

C-style printf formatting allows a pattern to be specified in the name of a source file or dataset. Strings for the file and dataset names are treated as literals except for the following substitutions:

|  |  |  |
| --- | --- | --- |
| “%%” | - | Replaced with a single ‘%’ character. |
| “%<*d>b*” | - | Where <d> is the virtual dataset dimension axis (0-based) and ‘b’ indicates that the block count of the selection in that dimension should be used. The full expression (for example, “%0b”) is replaced with a single numeric value when the mapping is evaluated at VDS access time. Example code for many source and virtual dataset mappings is available in the “Examples of Source to Virtual Dataset Mapping” chapter in “RFC: HDF5 Virtual Dataset” (see [1]). |

If the printf form is used for the source file or dataset names, the selection in the source dataset’s dataspace must be fixed-size; for more information see [1].

**Returns:**

Returns a non-negative value if successful; otherwise returns a negative value.

### H5Pget\_virtual\_count

**Name:** H5Pget\_virtual\_count

**Signature:**

*herr\_t* H5Pget\_virtual\_count (*hid\_t* dcpl\_id, *size\_t \**count)

**Purpose:**

Gets the number of mappings for the virtual dataset.

**Description:**

H5Pget\_virtual\_count gets the number of mappings for the virtual dataset that has a creation property list specified by the dcpl\_id parameter.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the virtual dataset creation property list. |
| *size\_t* \*count | - | IN: The number of mappings. |

**Returns:**

Returns a non-negative value if successful; otherwise returns a negative value.

### H5Pget\_virtual\_vspace

**Name:** H5Pget\_virtual\_vspace

**Signature:**

*hid\_t* H5Pget\_virtual\_vspace (*hid\_t* dcpl\_id, *size\_t* index)

**Purpose:**

Gets a dataspace identifier for the selection within the virtual dataset used in the mapping.

**Description:**

H5Pget\_virtual\_vspace takes the dataset creation property list for the virtual dataset, dcpl\_id, and the mapping index, index, and returns a dataspace identifier for the selection within the virtual dataset used in the mapping.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the virtual dataset creation property list. |
| *size\_t* index | - | IN: The mapping index. The index value i is 0iM, where M is number of mappings returned by the H5Pget\_virtual\_count function. |

**Returns:**

Returns a dataspace identifier; otherwise returns a negative value.

### H5Pget\_virtual\_srcspace

**Name:** H5Pget\_virtual\_srcspace

**Signature:**

*hid\_t* H5Pget\_virtual\_srcspace (*hid\_t* dcpl\_id, *size\_t* index)

**Purpose:**

Gets a dataspace identifier for the selection within the source dataset used in the mapping.

**Description:**

H5Pget\_virtual\_srcspace takes the dataset creation property list for the virtual dataset, dcpl\_id, and the mapping index, index, and returns a dataspace identifier for the selection within the source dataset used in the mapping.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the virtual dataset creation property list. |
| *size\_t* index | - | IN: The mapping index. The index value i is 0iM, where M is number of mappings returned by the H5Pget\_virtual\_count function. |

**Returns:**

Returns a dataspace identifier; otherwise returns a negative value.

### H5Pget\_virtual\_filename

**Name:** H5Pget\_virtual\_filename

**Signature:**

*ssize\_t* H5Pget\_virtual\_filename (*hid\_t* dcpl\_id, *size\_t* index, *char \**name, *size\_t* size)

**Purpose:**

Gets the filename of a source dataset used in the mapping.

**Description:**

H5Pget\_virtual\_filename takes the dataset creation property list for the virtual dataset, dcpl\_id, and the mapping index, index, and retrieves a name of a file for a source dataset used in the mapping.

Up to size characters of the filename are returned in name; additional characters, if any, are not returned to the user application.

If the length of the filename, which determines the required value of size, is unknown, a preliminary call to H5Pget\_virtual\_filename with the last two parameters set to NULL can be made. The return value of this call will be the size in bytes of the filename. That value, plus 1 for a NULL terminator, is then assigned to size for a second H5Pget\_virtual\_filename call, which will retrieve the actual filename.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the virtual dataset creation property list. |
| *size\_t* index | - | IN: The mapping index. The index value i is 0iM, where M is number of mappings returned by the H5Pget\_virtual\_count function. |
| *char \** name | - | OUT: A buffer containing the name of the file with the source dataset. |
| *size\_t* size | - | IN: The size of the name buffer; must be the size of the file name in bytes plus 1 for a NULL terminator. |

**Returns:**

Returns the length of the name if successful, otherwise returns a negative value.

### H5Pget\_virtual\_dsetname

**Name:** H5Pget\_virtual\_dsetname

**Signature:**

*ssize\_t* H5Pget\_virtual\_dsetname (*hid\_t* dcpl\_id, *size\_t* index, *char \**name, *size\_t* size)

**Purpose:**

Gets the name of a source dataset used in the mapping.

**Description:**

H5Pget\_virtual\_dsetname takes the dataset creation property list for the virtual dataset, dcpl\_id, and the mapping index, index, and retrieves the name of a source dataset used in the mapping.

Up to size characters of the name are returned in name; additional characters, if any, are not returned to the user application.

If the length of the filename, which determines the required value of size, is unknown, a preliminary call to H5Pget\_virtual\_dsetname with the last two parameters set to NULL can be made. The return value of this call will be the size in bytes of the filename. That value, plus 1 for a NULL terminator, is then assigned to size for a second H5Pget\_virtual\_dsetname call, which will retrieve the actual filename.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* dcpl\_id | *-* | IN: The identifier of the virtual dataset creation property list. |
| *size\_t* index | - | IN: The mapping index. The index value i is 0iM, where M is number of mappings returned by the H5Pget\_virtual\_count function. |
| *char \** name | - | OUT: A buffer containing the name of a source dataset. |
| *size\_t* size | - | IN: The size of the name buffer; must be the size of the name in bytes plus 1 for a NULL terminator. |

**Returns:**

Returns the length of the name if successful, otherwise returns a negative value.

### Example 1: VDS creation

This example shows how the H5Pget\_virtual\_\* APIS above are used. The source code of this example is available form <http://svn.hdfgroup.uiuc.edu/hdf5/features/vds/examples/h5_vds.c>

The program creates a virtual dataset that is displayed by h5dump as shown below:

$h5dump -pH vds.h5

HDF5 "vds.h5" {

GROUP "/" {

DATASET "VDS" {

DATATYPE H5T\_STD\_I32LE

DATASPACE SIMPLE { ( 4, 6 ) / ( 4, 6 ) }

STORAGE\_LAYOUT {

VIRTUAL {

HYPERSLAB { (0,0)-(0,5) };

a.h5;

A;

ALL ;

HYPERSLAB { (1,0)-(1,5) };

b.h5;

B;

ALL ;

HYPERSLAB { (2,0)-(2,5) };

c.h5;

C;

ALL;

}

}

}

FILTERS {

NONE

}

FILLVALUE {

FILL\_TIME H5D\_FILL\_TIME\_IFSET

VALUE -1

}

ALLOCATION\_TIME {

H5D\_ALLOC\_TIME\_INCR

}

}

}

}

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

This example illustrates the concept of virtual dataset.

The program creates three 1-dim source datasets and writes

data to them. Then it creates a 2-dim virtual dataset and

maps the first three rows of the virtual dataset to the data

in the source datasets. Elements of a row are mapped to all

elements of the corresponding source dataset.

The fourth row is not mapped and will be filled with the fill

values when virtual dataset is read back.

The program closes all datasets, and then reopens the virtual

dataset, and finds and prints its creation properties.

Then it reads the values.

This file is intended for use with HDF5 Library version 1.10

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

#include "hdf5.h"

#include <stdio.h>

#include <stdlib.h>

#define FILE "vds.h5"

#define DATASET "VDS"

#define VDSDIM1 6

#define VDSDIM0 4

#define DIM0 6

#define RANK1 1

#define RANK2 2

const char \*SRC\_FILE[] = {

"a.h5",

"b.h5",

"c.h5"

};

const char \*SRC\_DATASET[] = {

"A",

"B",

"C"

};

int

main (void)

{

hid\_t file, space, src\_space, vspace, dset; /\* Handles \*/

hid\_t dcpl;

herr\_t status;

hsize\_t vdsdims[2] = {VDSDIM0, VDSDIM1}, /\* Virtual satasets dimension \*/

dims[1] = {DIM0}, /\* Source datasets dimensions \*/

start[2], /\* Hyperslab parameters \*/

stride[2],

count[2],

block[2];

int wdata[DIM0], /\* Write buffer for source dataset \*/

rdata[VDSDIM0][VDSDIM1], /\* Read buffer for virtual dataset \*/

i, j, k, l;

int fill\_value = -1; /\* Fill value for VDS \*/

H5D\_layout\_t layout; /\* Storage layout \*/

size\_t num\_map; /\* Number of mappings \*/

ssize\_t len; /\* Length of the string; also a return value \*/

char \*filename;

char \*dsetname;

hsize\_t nblocks;

hsize\_t \*buf; /\* Buffer to hold hyperslab coordinates \*/

/\*

\* Create source files and datasets. This step is optional.

\*/

for (i=0; i < 3; i++) {

/\*

\* Initialize data for i-th source dataset.

\*/

for (j = 0; j < DIM0; j++) wdata[j] = i+1;

/\*

\* Create the source files and datasets. Write data to each dataset and

\* close all resources.

\*/

file = H5Fcreate (SRC\_FILE[i], H5F\_ACC\_TRUNC, H5P\_DEFAULT, H5P\_DEFAULT);

space = H5Screate\_simple (RANK1, dims, NULL);

dset = H5Dcreate (file, SRC\_DATASET[i], H5T\_NATIVE\_INT, space, H5P\_DEFAULT,

H5P\_DEFAULT, H5P\_DEFAULT);

status = H5Dwrite (dset, H5T\_NATIVE\_INT, H5S\_ALL, H5S\_ALL, H5P\_DEFAULT,

wdata);

status = H5Sclose (space);

status = H5Dclose (dset);

status = H5Fclose (file);

}

/\* Create file in which virtual dataset will be stored. \*/

file = H5Fcreate (FILE, H5F\_ACC\_TRUNC, H5P\_DEFAULT, H5P\_DEFAULT);

/\* Create VDS dataspace. \*/

space = H5Screate\_simple (RANK2, vdsdims, NULL);

/\* Set VDS creation property. \*/

dcpl = H5Pcreate (H5P\_DATASET\_CREATE);

status = H5Pset\_fill\_value (dcpl, H5T\_NATIVE\_INT, &fill\_value);

/\* Initialize hyperslab values. \*/

start[0] = 0;

start[1] = 0;

count[0] = 1;

count[1] = 1;

block[0] = 1;

block[1] = VDSDIM1;

/\*

\* Build the mappings.

\* Selections in the source datasets are H5S\_ALL.

\* In the virtual dataset we select the first, the second and the third rows

\* and map each row to the data in the corresponding source dataset.

\*/

src\_space = H5Screate\_simple (RANK1, dims, NULL);

for (i = 0; i < 3; i++) {

start[0] = (hsize\_t)i;

/\* Select i-th row in the virtual dataset; selection in the source datasets is the same. \*/

status = H5Sselect\_hyperslab (space, H5S\_SELECT\_SET, start, NULL, count, block);

status = H5Pset\_virtual (dcpl, space, SRC\_FILE[i], SRC\_DATASET[i], src\_space);

}

/\* Create a virtual dataset. \*/

dset = H5Dcreate (file, DATASET, H5T\_NATIVE\_INT, space, H5P\_DEFAULT,

dcpl, H5P\_DEFAULT);

status = H5Sclose (space);

status = H5Sclose (src\_space);

status = H5Dclose (dset);

status = H5Fclose (file);

/\*

\* Now we begin the read section of this example.

\*/

/\*

\* Open the file and virtual dataset.

\*/

file = H5Fopen (FILE, H5F\_ACC\_RDONLY, H5P\_DEFAULT);

dset = H5Dopen (file, DATASET, H5P\_DEFAULT);

/\*

\* Get creation property list and mapping properties.

\*/

dcpl = H5Dget\_create\_plist (dset);

/\*

\* Get storage layout.

\*/

layout = H5Pget\_layout (dcpl);

if (H5D\_VIRTUAL == layout)

printf(" Dataset has a virtual layout \n");

else

printf("Wrong layout found \n");

/\*

\* Find the number of mappings.

\*/

status = H5Pget\_virtual\_count (dcpl, &num\_map);

printf("Number of mappings is %d\n", num\_map);

/\*

\* Get mapping parameters for each mapping.

\*/

for (i = 0; i < (int)num\_map; i++) {

printf("Mapping %d \n", i);

printf(" Selection in the virtual dataset ");

/\* Get selection in the virttual dataset \*/

vspace = H5Pget\_virtual\_vspace (dcpl, (size\_t)i);

/\* Make sure that this is a hyperslab selection and then print information. \*/

if (H5Sget\_select\_type(vspace) == H5S\_SEL\_HYPERSLABS) {

nblocks = H5Sget\_select\_hyper\_nblocks (vspace);

buf = (hsize\_t \*)malloc(sizeof(hsize\_t)\*2\*RANK2\*nblocks);

status = H5Sget\_select\_hyper\_blocklist (vspace, (hsize\_t)0, nblocks, buf);

for (l=0; l<nblocks; l++) {

printf("(");

for (k=0; k<RANK2-1; k++)

printf("%d,", (int)buf[k]);

printf("%d ) - (", (int)buf[k]);

for (k=0; k<RANK2-1; k++)

printf("%d,", (int)buf[RANK2+k]);

printf("%d)\n", (int)buf[RANK2+k]);

}

}

/\* Get source file name. \*/

len = H5Pget\_virtual\_filename (dcpl, (size\_t)i, NULL, 0);

filename = (char \*)malloc((size\_t)len\*sizeof(char)+1);

H5Pget\_virtual\_filename (dcpl, (size\_t)i, filename, len+1);

printf(" Source filename %s\n", filename);

/\* Get source dataset name. \*/

len = H5Pget\_virtual\_dsetname (dcpl, (size\_t)i, NULL, 0);

dsetname = (char \*)malloc((size\_t)len\*sizeof(char)+1);

H5Pget\_virtual\_dsetname (dcpl, (size\_t)i, dsetname, len+1);

printf(" Source dataset name %s\n", dsetname);

/\* Get selection in the source dataset. \*/

printf(" Selection in the source dataset ");

src\_space = H5Pget\_virtual\_srcspace (dcpl, (size\_t)i);

/\* Make sure it is ALL selection and then print the coordinates. \*/

if(H5Sget\_select\_type(src\_space) == H5S\_SEL\_ALL) {

printf("(0) - (%d) \n", DIM0-1);

}

H5Sclose(vspace);

H5Sclose(src\_space);

free(filename);

free(dsetname);

free(buf);

}

#ifdef LATER

/\*

\* Read the data using the default properties.

\*/

status = H5Dread (dset, H5T\_NATIVE\_INT, H5S\_ALL, H5S\_ALL, H5P\_DEFAULT,

rdata[0]);

/\*

\* Output the data to the screen.

\*/

printf (" VDS Data:\n");

for (i=0; i<VDSDIM0; i++) {

printf (" [");

for (j=0; j<VDSDIM1; j++)

printf (" %3d", rdata[i][j]);

printf ("]\n");

}

#endif

/\*

\* Close and release resources.

\*/

status = H5Pclose (dcpl);

status = H5Dclose (dset);

status = H5Fclose (file);

return 0;

}

# New APIs in support of VDS feature

## H5S APIs

This section contains new APIs for the H5S interface needed to query properties of the regular hyperslab selections.

### H5Sis\_regular\_hyperslab

**Name:** H5Sis\_regular\_hyperslab

**Signature:**

*htri\_t* H5Sis\_regular\_hyperslab (*hid\_t* space\_id)

**Purpose:**

Determines if a hyperslab selection is regular.

**Description:**

Regular hyperslab selection is a hyperslab selection described by setting the offset, stride, count and block parameters to H5select\_hyperslab. If several calls to H5select\_hyperslab are needed, then the hyperslab selection is irregular.

H5Sis\_regular\_hyperslab takes the dataspace identifier, space\_id, and queries the type of the hyperslab selection.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* space\_id | *-* | IN: The identifier of the dataspace. |

**Returns:**

Returns TRUE/FALSE for hyperslab selection; FAIL on error or when querying other selection types such as point selection.

### H5Sget\_regular\_hyperslab

**Name:** H5Sget\_regular\_hyperslab

**Signature:**

*herr\_t* H5Pget\_regular\_hyperslab (*hid\_t* space\_id, *hsize\_t* start[], *hsize\_t* stride[], *hsize\_t* count[], *hsize\_t* block[])

**Purpose:**

Retrieves a regular hyperslab selection.

**Description:**

Regular hyperslab selection is a hyperslab selection described by setting the offset, stride, count and block parameters to H5select\_hyperslab. If several calls to H5select\_hyperslab are needed, then the hyperslab selection is irregular.

H5Pget\_regular\_hyperslab takes the dataspace identifier, space\_id, and retrieves the values of start, stride, count, and block for the regular hyperslab selection.

**Note:**

Note that if a hyperslab selection is originally regular, then becomes irregular through selection operations, and then becomes regular again, the new final regular selection may be equivalent but not identical to the original regular selection.

**Parameters:**

|  |  |  |
| --- | --- | --- |
| *hid\_t* space\_id | *-* | IN: The identifier of the dataspace. |
| *hsize\_t* start[] | - | OUT: Offset of start of a regular hyperslab. |
| *hsize\_t* stride[] | - | OUT: Stride of the regular hyperslab. |
| *hsize\_t* count[] | - | OUT: Number of blocks in the regular hyperslab. |
| *hsize\_t* block[] | - | OUT: Size of block in the regular hyperslab. |

**Returns:**

Returns the non-negative value if successful, otherwise returns a negative value.

# References:

1. “RFC: HDF5 Virtual Dataset”, The HDF Group, <https://confluence.hdfgroup.uiuc.edu/display/HDFExternal/HDF5+Virtual+Dataset>

# Revision History

|  |  |
| --- | --- |
| February 10, 2015 | Version 1 circulated for comment within The HDF Group. |
| February 11, 2015 | Version 2. Names of the APIs were updated according to suggestions made during the code review session on 2/10/2015. Document circulated for comment within The HDF Group. |
| February 24, 2015 | Version 3. Added an example for the H5Pget\_virtual\_\* functions. |
| March 2, 2015 | Version 4. Added section for the H5S\* functions. |