HDF5 Update

High-Data Rate MX Meeting
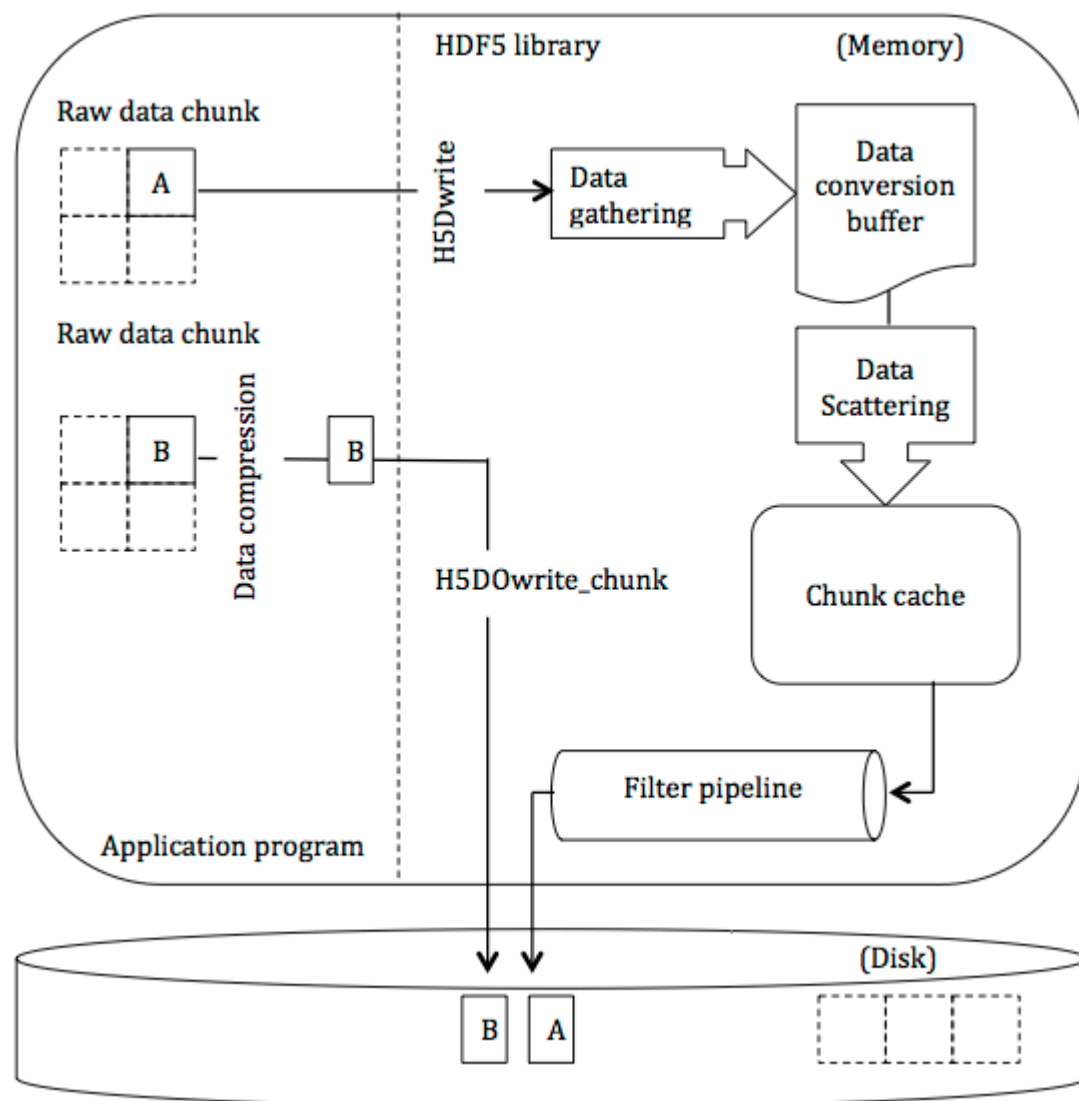
NSLS-II at BNL

May 26, 2016

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- HDF5 features requested and sponsored by Synchrotron Community (2012 -2016)
  - Direct chunk I/O (PSI, Dectris)
  - Dynamically loaded filters (DESY)
  - Single Write/ Multiple Reader or SWMR (DLS, ESRF, DESY)
  - Virtual Dataset (VDS) (DLS, DESY, XFEL)
- New requirements and features
- HDF5 roadmap for 2016

Direct chunk write: H5DOwrite_chunk

Performance results for H5DOwrite_chunk

Test result on Lunux 2.6, x86_64
Each dataset contained 100 chunks, written by chunks

	95.37		762.94		2288.82	
Dataset size (MB)	95.37		762.94		2288.82	
Size after compression (MB)	64.14		512.94		1538.81	
Dataset dimensionality	100x1000x250		100x2000x1000		100x2000x3000	
Chunk dimensionality	1000x250		2000x1000		2000x3000	
Datatype	4-byte integer		4-byte integer		4-byte integer	
	speed[1]	time[2]	speed	time	speed	time
H5Dwrite writes without compression filter	77.27	1.23	97.02	7.86	91.77	24.94
H5DOwrite_chunk writes uncompressed data	79	1.21	95.71	7.97	89.17	25.67
H5Dwrite writes with compression filter	**2.68**	**35.59**	**2.67**	**285.75**	**2.67**	**857.24**
H5DOwrite_chunk writes compressed data	**77.19**	**0.83**	**78.56**	**6.53**	**96.28**	**15.98**
Unix writes compressed data to Unix file	76.49	0.84	95	5.4	98.59	15.61

1 Speed in MB/s
2 Time in seconds

Dynamically loaded filters

- Problems with using custom filters
  - "Off the shelf" tools do not work with the third-party filters
    - h5dump, MATLAB and IDL, etc.
  - HDF5 tools cannot read file created by
    - h5py, PyTables , etc.
- Solution
  - Modify HDF5 source with your code and distribute it
    - And what will happen if a user wants filters from the different distributions???? Oh…. No….
  - Use a 1.8.11 and later
  - Provide maintained library of HDF5 compression filters
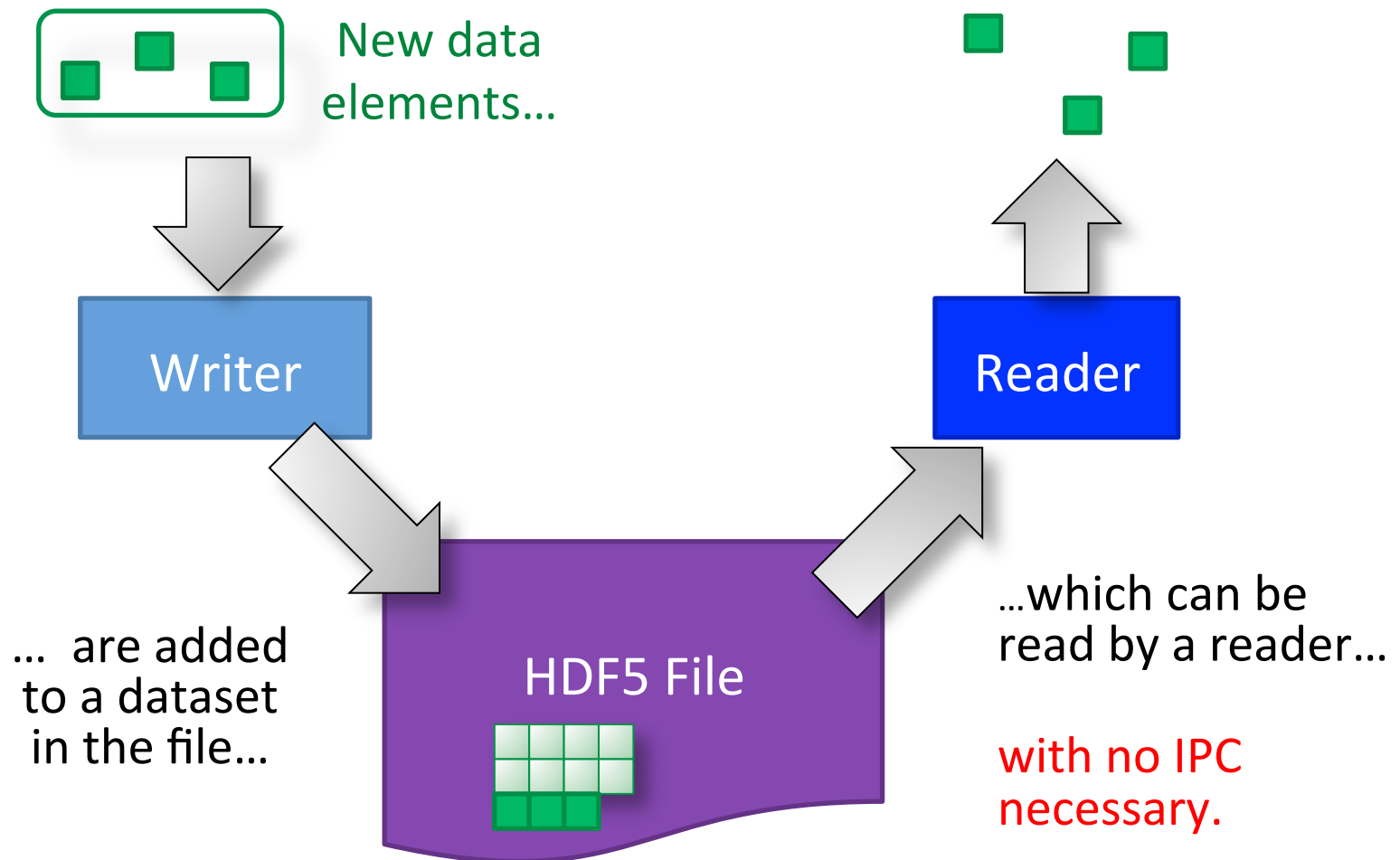
Approach

- There are predefined default locations where the HDF5 library searches the shared libraries or DLLs with the HDF5 filter functions.

- The default location may be overwritten by an environment variable.

- Encoding: Standard programming model to register compression filter on write operation

- Decoding: Transparent on read; no user action required.

- Works great, but….

User's headache and possible solutions

- Where to find HDF5 plugins?
- No official distribution site
  - Example of HDF5 filters distributions on Github
    - https://github.com/dectris/HDF5Plugin
    - https://github.com/Blosc/hdf5-blosc
    - https://github.com/nexusformat/HDF5-External-Filter-Plugins
    - https://svn.hdfgroup.org/hdf5_plugins/
- The HDF Group can help with
  - Maintaining common repository
  - Testing plugin with the releases
  - Distributing source and binaries for Linux, Mac and Windows
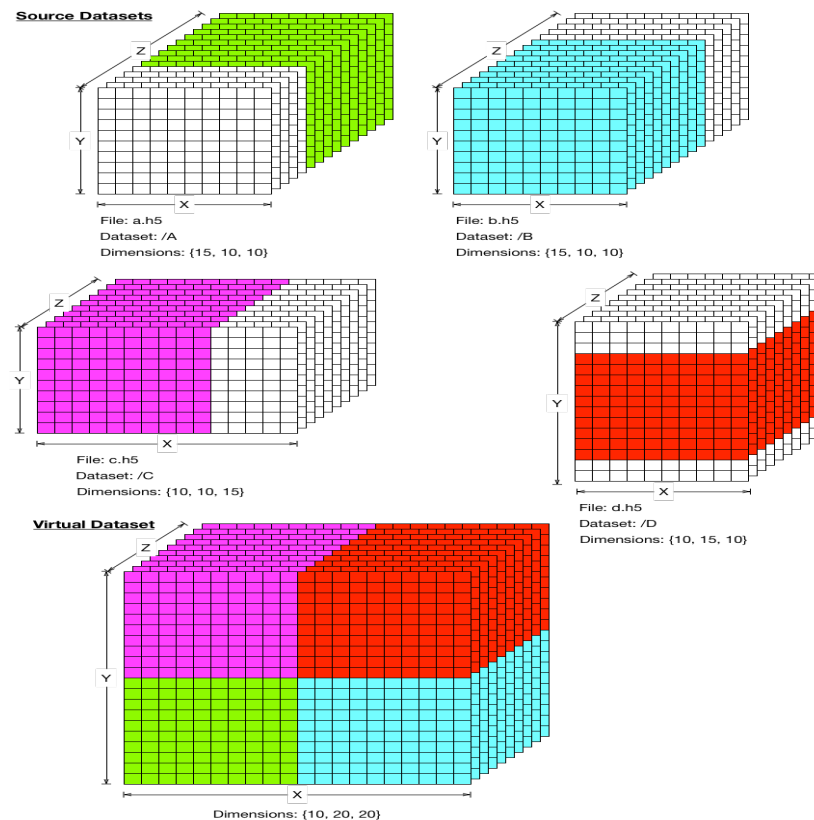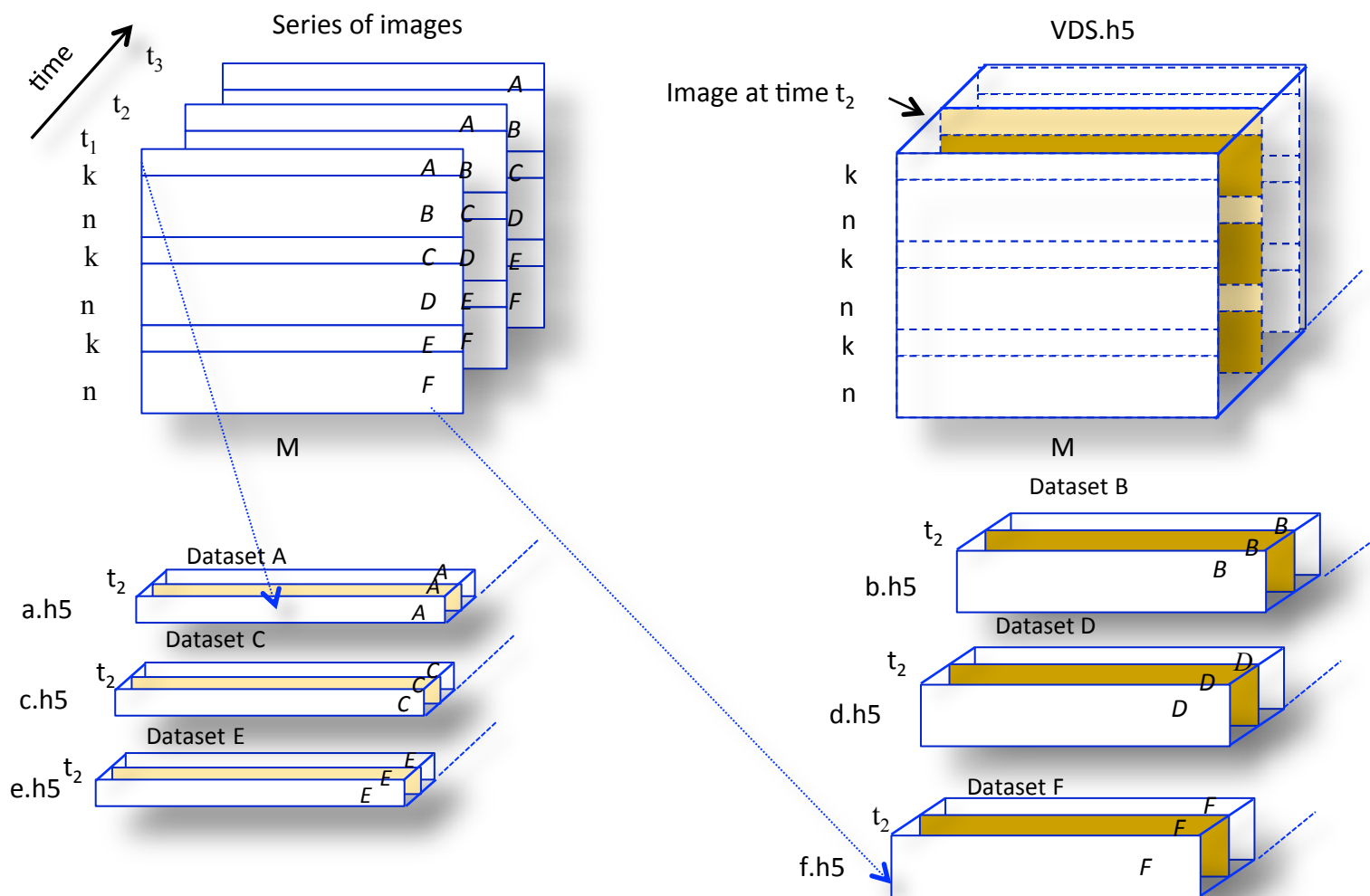   - Free and licensed (for fee) binary distributions

SWMR: Data access to file being written

New data
elements…

Writer

... are added
to a dataset
in the file…

HDF5 File

Reader

…which can be
read by a reader…

with no IPC
necessary.

- Released in HDF5 1.10.0

- Restricted to append-data only scenario

- SWMR doesn't work on NFS

- Files are not compatible with HDF5 1.8.* libraries

- Use h5format_convert tool

  - Converts HDF5 metadata in place

  - No raw data is rewritten

• Data stored in multiple files and datasets can be accessed via one dataset (VDS) using standard HDF5 read/write

VDS Example

Series of images

time
t_3
t_2
t_1

k
n
k
n
k
n

A
A B
A B C
B C D
C D E
D E F
E F
F

M

VDS.h5

Image at time t_2

k
n
k
n
k
n

M

Dataset A
t_2
a.h5
A
A
A

Dataset C
t_2
c.h5
C
C
C

Dataset E
t_2
e.h5
E
E
E

Dataset B
t_2
b.h5
B
B
B

Dataset D
t_2
d.h5
D
D
D

Dataset F
t_2
f.h5
F
F
F

- VDS works with SWMR

- File with VDS cannot be accessed by HDF5 1.8.* libraries

- Use h5repack tool to rewrite data (1.10.0-patch1)

New requirements and features?

- Tell us your needs:
    - Multi-threaded compression filters
    - H5DOread_chunk function
    - Full SWMR implementation
    - Performance
    - Backward/forward compatibility
- Other requests?

- ## May 31 -HDF5 1.10.0-patch1
  - ### H5repack, Windows builds, Fortran issues on HPC systems

- ## Mid-summer HDF5 1.10.1
  - ### Some internal issues found for 1.10.0

- ## December
  - ### HPC features that didn't make it into 1.10.0 release

Thank you!