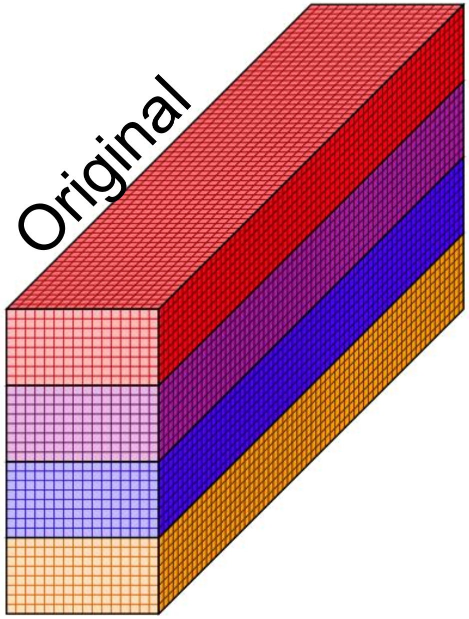
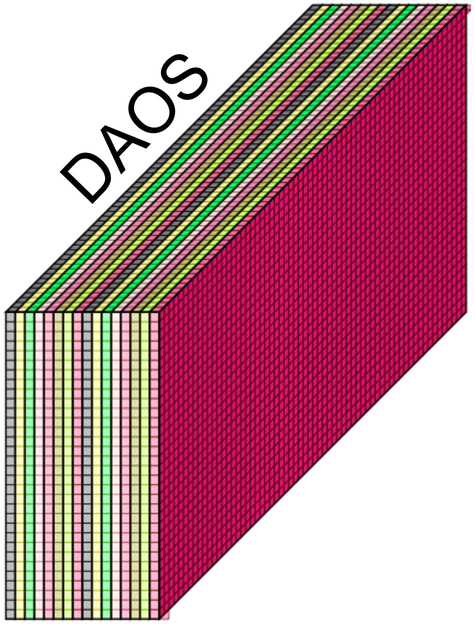
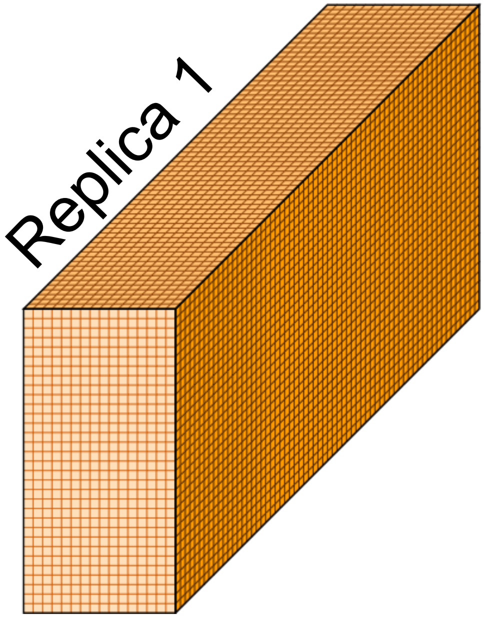


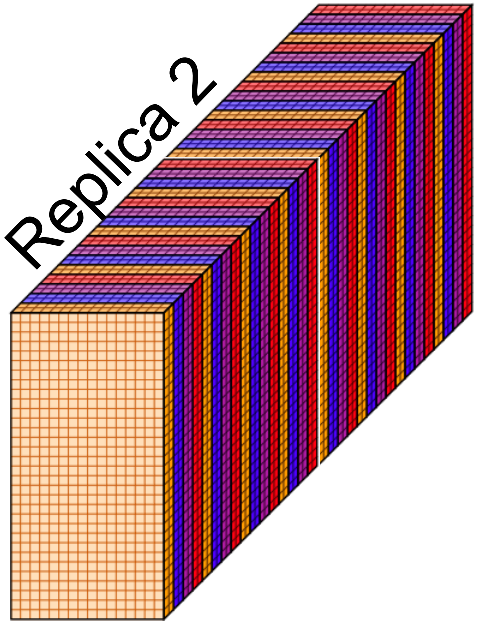
EFF-IO M7.5 Demo



Semantic Migration of Multi-dimensional Arrays

John Bent, Sorin Faibish, Xuezhao Liu, Harriet Qui, Haiying Tang, Jerry Tirrell, Jingwang Zhang, Kelly Zhang, Zhenhua Zhang





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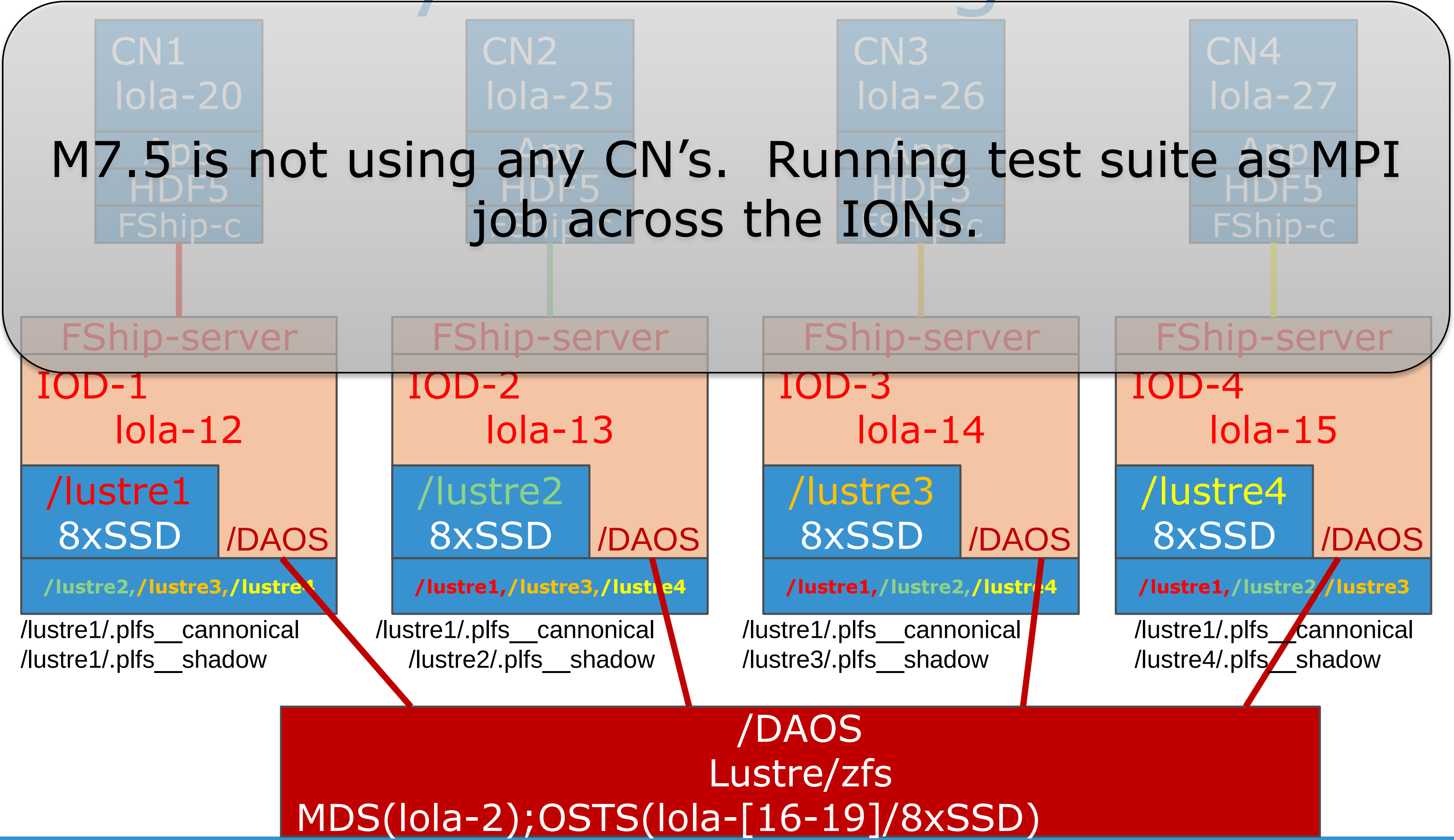
Demo System Configuration

- IONS: Four IONs
  - lola-[12-15].hpdd.intel.com
  - 8 SSD burst buffers on each
- DAOS: Global /mnt/daos mount on each
  - DAOS-lustre
  - MDS(lola-2);OSTS(lola-[16-19]/8xSSD)
- BB's: Local /mnt/lustre[1-4] on each ION
  - All IONs have lustre cross-mounts to all BB's
- CN's: Four CNs available via Mercury
  - lola-[20,25-27]
  - Our demo runs directly on ION's though without HDF
    - MPI job making calls directly to IOD API

Demo System Configuration



M7.5 is not using any CN's. Running test suite as MPI job across the IONs.

Demo scope

- Semantic migration of arrays
  - Persist (IOD -> DAOS)
  - Fetch (DAOS -> IOD)
- Dimensional sequence transformation
  - Changing the access dimension
- Reading from a persisted / purge array
  - i.e. Reading directly from DAOS
- Query layout / sharding

Initialization 1/2

```
Script started on Fri 21 Mar 2014 09:21:30 AM PDT
jim.pedone@lola-3:/scratch/iod/M7.5_demo
root@lola-3 M7.5_demo]# ./M7.5_demo1.sh
Cleaning the BB's and DAOS to return to initial state.

M7.5 demonstration 1 -- Array Migration.
will run M7.5_case1_array_migration_ops on 4 IODS: lola-12 lola-13 lola-14 lola-15
> mpirun -np 4 -hosts lola-12,lola-13,lola-14,lola-15 -c demo_config -t
M7.5_case1_array_migration_ops
Fri Mar 21 09:21:41 PDT 2014

*********  Test Configuration   *********
           inputFile     = M7.5_case1_array_migration_ops
           nproc         =                  4
           all_async     =                 True
```

Initialization 2/2

```
========================================================================
# Demonstration: Array Migration, Data Reorganization and Layout Discovery
#
# This demonstration will cover these elements:
# Migration of array objects using structural descriptions between DAOS and IODs
# - Will be shown in both directions
# Reorganization of data layout during migration for array objects
# - E.g. Migrate using a layout which specifies a different dimension sequence
# Layout query of array objects
# - E.g. Returning structure set to place data when migrating to DAOS
#
# Out of scope demonstration elements:
# - Similar functionality for KV objects and blob objects will not be
# demonstrated at this time
# ========================================================================
```

Step 1: Create and open container

```
Running command: * contopen /containerA create
Call iod_container_open(), path: /containerA, open_mode: 0x83...
Finish to open container - passed (rc = 0)
```

Step 2.1 – 2.2: Skip Transaction 0

```
Running command: 0 transstart 0 write
Call iod_trans_start(), tid: 0x0, num_ranks: 0, mode: 0x2...
Finish to start transaction - passed (rc = 0)
# ######## Step 2.2 - finish TID0 for write
# Command format: tid transfinish flag
# flag ---------- only meaningful for writing transaction. 'normal' for commonly finish
> Press enter to continue...

Running command: 0 transfinish normal
Call iod_trans_finish(), tid: 0x0, num_ranks: 0, flag: 0
Finish to finish transaction - passed (rc = 0)
```

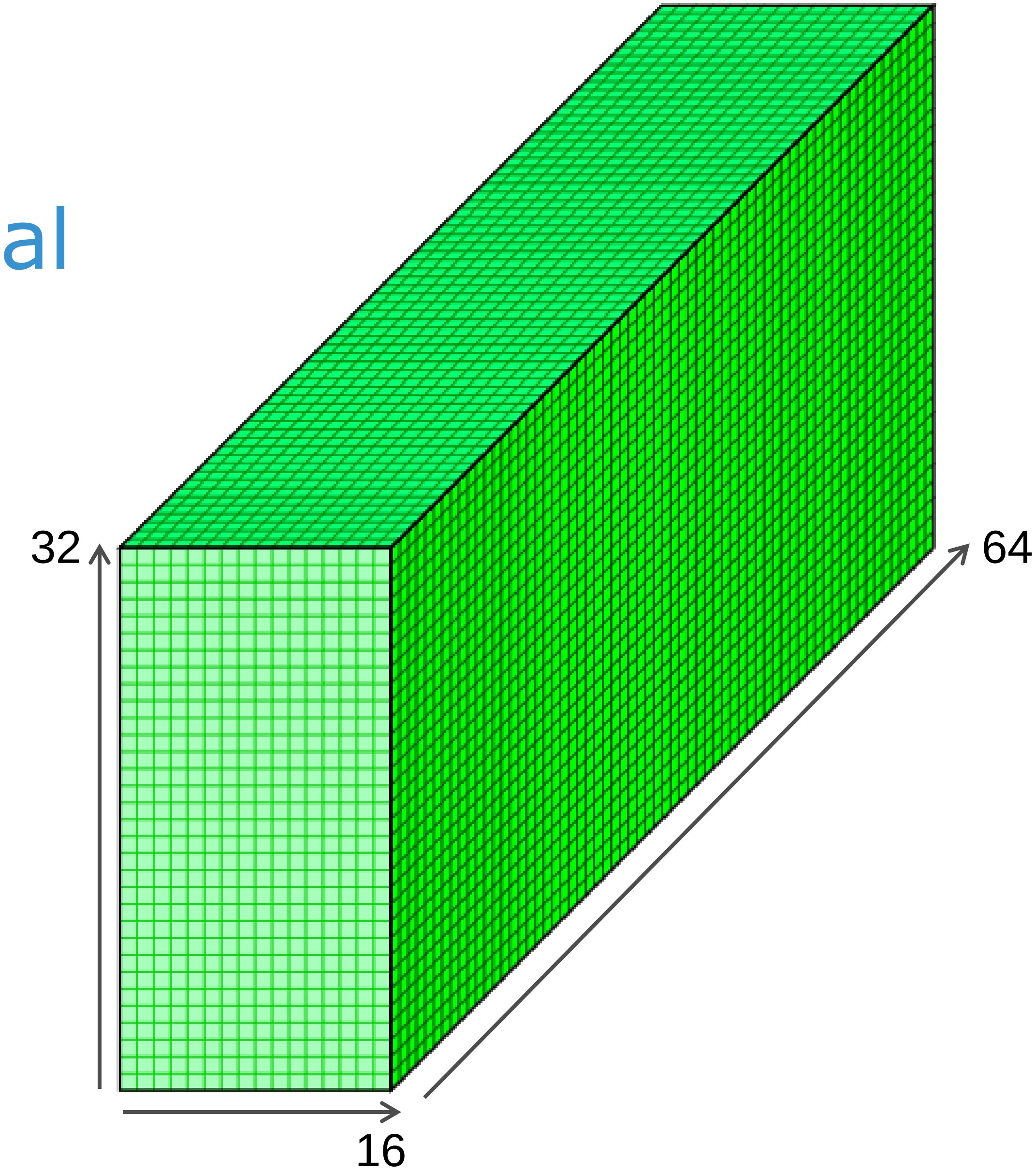
Step 2.3 – 2.4: Start TID=1, create array

Leader mode

```
Running command: 1 transstart 0 write
Call iod_trans_start(), tid: 0x1, num_ranks: 0, mode: 0x2...
Finish to start transaction - passed (rc = 0)

# ######## Step 2.4 - in TID1, create ARRAY object:
            cell_size=32 num_dims=3 (16 X 32 X 64)
> Press enter to continue...

Running command: 1 create array array_obj 32 3 16,32,64 16
Call iod_obj_create(), tid: 0x1, type: 0x3...
Array struct: cell_size: 512, num_dims:  3, firstdim_max: 16, current_dims: 16,32,64
Finish to create object - passed (rc = 0)
```

16MB array
(512x16x32x64)

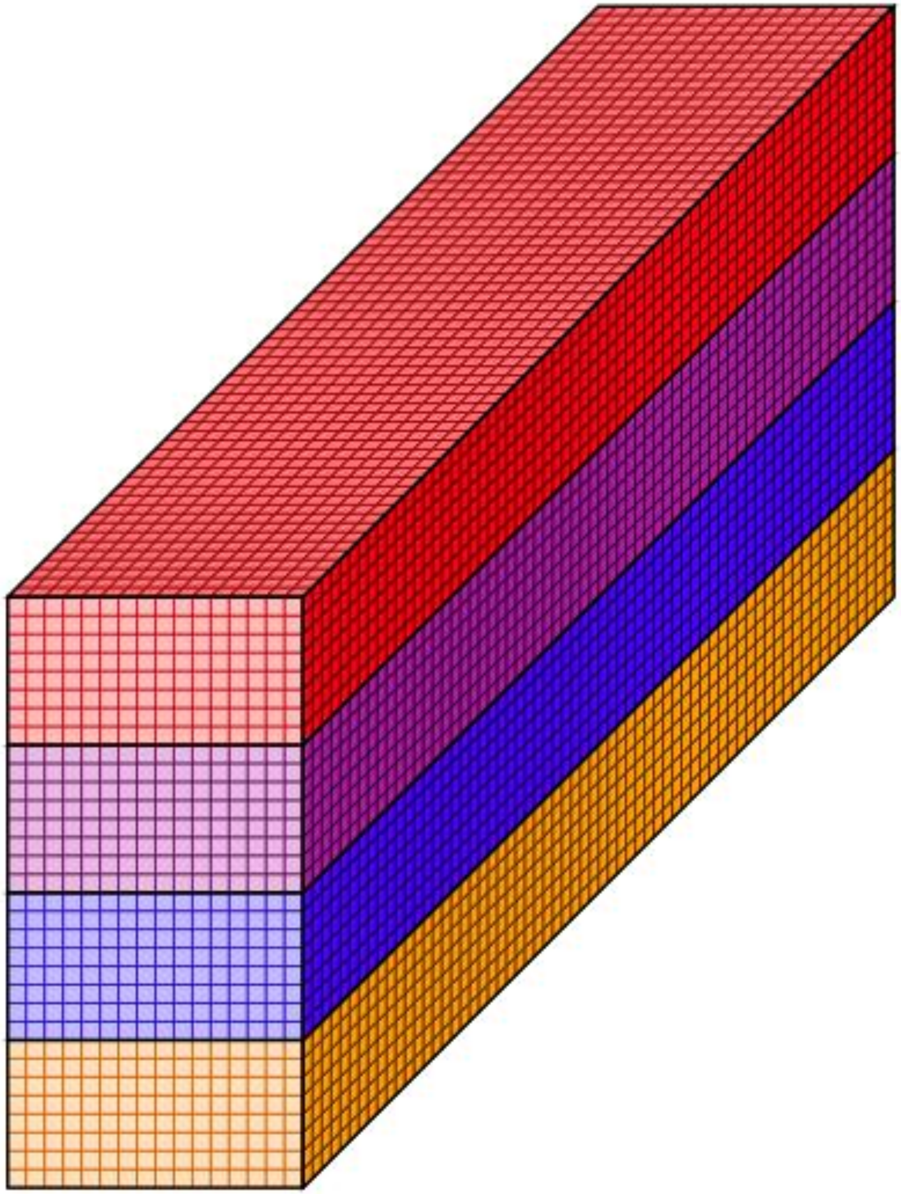
16 x 32 x 64 Multi-dimensional Array



Step 2.5: Write into array

```
# Call iod_array_write() to write the ARRAY object
# start is [0,0,0], stride is [8,8,8], count is [2,4,8], block is [8,8,8]
#
> Press enter to continue...

Running command: 1 write array_obj 0,0,0 8,8,8 2,4,8 8,8,8
Rank 0 ID 0: start[ 0,0,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 1 ID 0: start[ 0,8,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 2 ID 0: start[ 0,16,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 3 ID 0: start[ 0,24,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Call iod_array_write(), oh: 123, tid: 0x1
Rank 0 ID 0: iod_array_write() returns 0
Rank 1 ID 0: iod_array_write() returns 0
Rank 3 ID 0: iod_array_write() returns 0
Rank 2 ID 0: iod_array_write() returns 0
Finish to write array - passed (rc = 0)
```

Write Pattern



Rank 3

Rank 2

Rank 1

Rank 0

Step 2.6: Prepare semantic persist

```
# location ------ "DAOS" (i.e. IOD_LOC_CENTRAL)
# type ---------- currently only support stripped layout (i.e.IOD_LAYOUT_STRIPED).
# target_start -- the offset in DAOS shard list, currently IOD ignores this value
                  (chooses one internally for load balance).
# target_num ---- number of storage targets (i.e. DAOS shards). If 0, it defaults to all shards.
# stripe_size --- resharding granularity. The number of cells for contiguous layout array.
# dims_seq ------ For contigous layout, it is an array with num_dims size (i.e. a 4D array may have
# [3][2][1][0] as its logical dimension sequence)
Running command: 1 setlayout array_obj DAOS,striped,0,2,128,<1,2,0>
Call iod_obj_set_layout(), tid: 0x1
Layout to set:
location   type      target_start  target_num  stripe_size   dims_seq
DAOS       striped     1             8           2048          1, 2, 0
Finish to set object layout - passed (rc = 0)
```

Step 2.7: Commit TID=1

```
Running command: 1 transfinish normal
Call iod_trans_finish(), tid: 0x1, num_ranks: 0, flag: 0
Finish to finish transaction - passed (rc = 0)
```

Step 3.2: Query Eventual Persist Layout

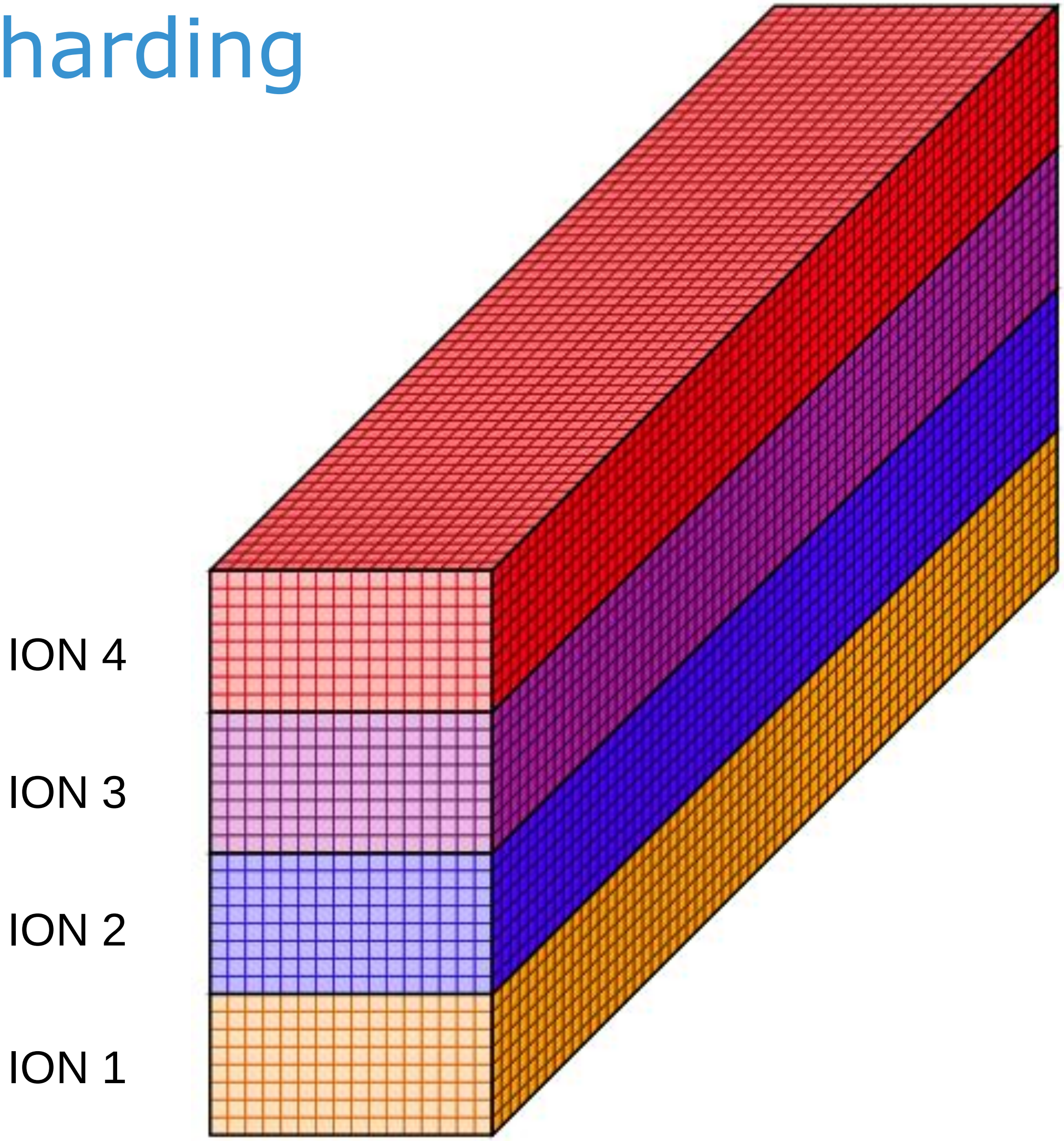
```
Running command: 1 getlayout array_obj
At tid 0x1: dump IOD returned layout:
location    type        target_start  target_num  stripe_size   dims_seq
DAOS        striped     1             8           2048          1, 2, 0
Rank 0 ID 0: get_layout verification succeed
Finish to get object layout - passed (rc = 0)
```

Step 3.3: Query Semantic Shards on IONs

```
Running command: 1 querymap array_obj
Call iod_obj_query_map(), tid: 0x1
Rank 0 in tid 0x1: dump IOD returned map:

obj_id            type      n_range
6000000171b6056d  ARRAY     64

range:  0, start:  0,  0,  0,  end:  0,  7, 63,  n_cell:   512, loc: /mnt/lustre1/.plfs__shadow
range:  1, start:  0,  8,  0,  end:  0, 15, 63,  n_cell:   512, loc: /mnt/lustre2/.plfs__shadow
range:  2, start:  0, 16,  0,  end:  0, 23, 63,  n_cell:   512, loc: /mnt/lustre3/.plfs__shadow
range:  3, start:  0, 24,  0,  end:  0, 31, 63,  n_cell:   512, loc: /mnt/lustre4/.plfs__shadow
range:  4, start:  1,  0,  0,  end:  1,  7, 63,  n_cell:   512, loc: /mnt/lustre1/.plfs__shadow
range:  5, start:  1,  8,  0,  end:  1, 15, 63,  n_cell:   512, loc: /mnt/lustre2/.plfs__shadow
range:  6, start:  1, 16,  0,  end:  1, 23, 63,  n_cell:   512, loc: /mnt/lustre3/.plfs__shadow
range:  7, start:  1, 24,  0,  end:  1, 31, 63,  n_cell:   512, loc: /mnt/lustre4/.plfs__shadow
<snip>
range: 56, start: 14,  0,  0,  end: 14,  7, 63,  n_cell:   512, loc: /mnt/lustre1/.plfs__shadow
range: 57, start: 14,  8,  0,  end: 14, 15, 63,  n_cell:   512, loc: /mnt/lustre2/.plfs__shadow
range: 58, start: 14, 16,  0,  end: 14, 23, 63,  n_cell:   512, loc: /mnt/lustre3/.plfs__shadow
range: 59, start: 14, 24,  0,  end: 14, 31, 63,  n_cell:   512, loc: /mnt/lustre4/.plfs__shadow
range: 60, start: 15,  0,  0,  end: 15,  7, 63,  n_cell:   512, loc: /mnt/lustre1/.plfs__shadow
range: 61, start: 15,  8,  0,  end: 15, 15, 63,  n_cell:   512, loc: /mnt/lustre2/.plfs__shadow
range: 62, start: 15, 16,  0,  end: 15, 23, 63,  n_cell:   512, loc: /mnt/lustre3/.plfs__shadow
range: 63, start: 15, 24,  0,  end: 15, 31, 63,  n_cell:   512, loc: /mnt/lustre4/.plfs__shadow
```

Result of write pattern

Semantic Sharding on IONs



ION 4

ION 3

ION 2

ION 1

Step 3.3: Query Semantic Shards on IONs

```
# Verify data in BB’s:
[root@lola-3 scripts]# plfs_query /tmp/iod_plfs/containerA/6000000110246979/1 \
            | grep dropping.data | xargs du -h
4.0M
           /mnt/lustre7/.plfs__shadow///containerA/6000000110246979/1/hostdir.1/droppin
g.data.1395627045.428540.lola-7.lola.whamcloud.com.114393
4.0M
           /mnt/lustre6/.plfs__shadow///containerA/6000000110246979/1/hostdir.2/droppin
g.data.1395627006.948952.lola-6.lola.whamcloud.com.112589
4.0M
           /mnt/lustre5/.plfs__shadow///containerA/6000000110246979/1/hostdir.3/droppin
g.data.1395626999.206627.lola-5.lola.whamcloud.com.57576
4.0M
           /mnt/lustre3/.plfs__shadow///containerA/6000000110246979/1/hostdir.5/droppin
g.data.1395626997.366273.lola-3.lola.whamcloud.com.109024
```

Step 4.1: Persist container at TID=1

```
Running command: 1 persist
Call iod_trans_persist(), coh: 25, tid : 0x1...
Finish to persist container - passed (rc = 0)
```

```
# Verify proper scatter-gather migration:
> [root@lola-3 scripts]# egrep 'reqmsg|ACK' /tmp/iod.debug.log | head
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO handling reqmsg, type: 1, msg_len: 63.(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO ENTER: _container_ops_trans_start_reqmsg_handler (rank 0)(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO EXIT : _container_ops_trans_start_reqmsg_handler, rc: 0.(rank 0)(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO handling reqmsg, type: 1, msg_len: 63.(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO ENTER: _container_ops_trans_start_reqmsg_handler (rank 0)(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO EXIT : _container_ops_trans_start_reqmsg_handler, rc: 0.(rank 0)(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO sending ACK req_id 2, result: 0, piggyback: ffffffffffffffff from 0 to 0 ... (rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO handling reqmsg, type: 2, msg_len: 32.(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO ACK arrived, from IOD rank 0, req_id: 2, result: 0.(rank 0)
2014/03/23-16:52:33.07 lola-3 plfs[107367] IOD  INFO ENTER: iod_reqmsg_ack_handler (rank 0)(rank 0)
```

Step 4.1: Persist container at TID=1

```
# Verify data on DAOS:
> [root@lola-3 scripts]# ./daos_query.sh /mnt/daos/containerA
[root@lola-3 scripts]# daos_query.sh /mnt/daos/containerA
/scratch/iod/tests/output/daos_query.sh/Mar.23.2014.19.56
### ls -l /mnt/daos/containerA
-rw-r--r-- 1 root root 4294967296 Mar 23 19:55 /mnt/daos/containerA
### du -h /mnt/daos/containerA
27M          /mnt/daos/containerA
#### daos_ctl run -c /mnt/daos/containerA Cor,Cq,Eq,Cc: 1
HCE is 1
#### daos_ctl run -c /mnt/daos/containerA Cor,Cq,Eq,Cc: 8
8 shards
#### daos_ctl run -c /mnt/daos/containerA Cor,Sq1:0,Sl1:0,Cc: 141,
Shard 0 has 141, objects and uses 16244736 (15 MB)
Objects in shard 0: [0:2377900603251621889] [0:2377900603251621890] [0:2377900603251621891]
[0:2377900603251621892] [0:6917529032887005706]
#### daos_ctl run -c /mnt/daos/containerA Cor,Sq1:1,Sl1:1,Cc: 5480448
Shard 1 has 135, objects and uses 5480448 (5 MB)
Objects in shard 1: [1:6917529032887005706]
<snip>
#### daos_ctl run -c /mnt/daos/containerA Cor,Sq1:7,Sl1:7,Cc: 5480448
Shard 7 has 135, objects and uses 5480448 (5 MB)
Objects in shard 7: [7:6917529032887005706]
```

Semantic Sharding on DAOS

KEY

Shard0

Shard1

Shard2

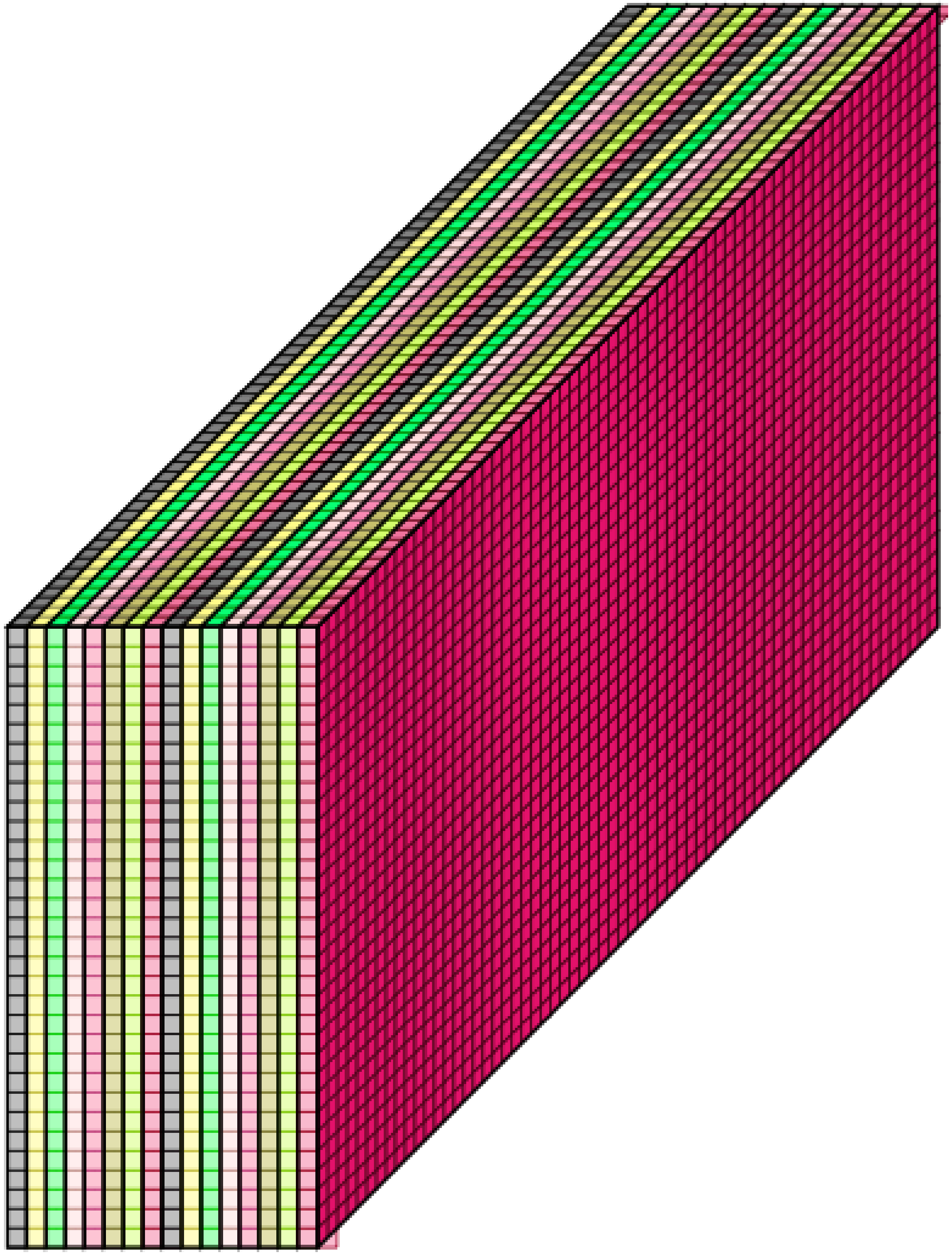
Shard3

Shard4

Shard5

Shard6

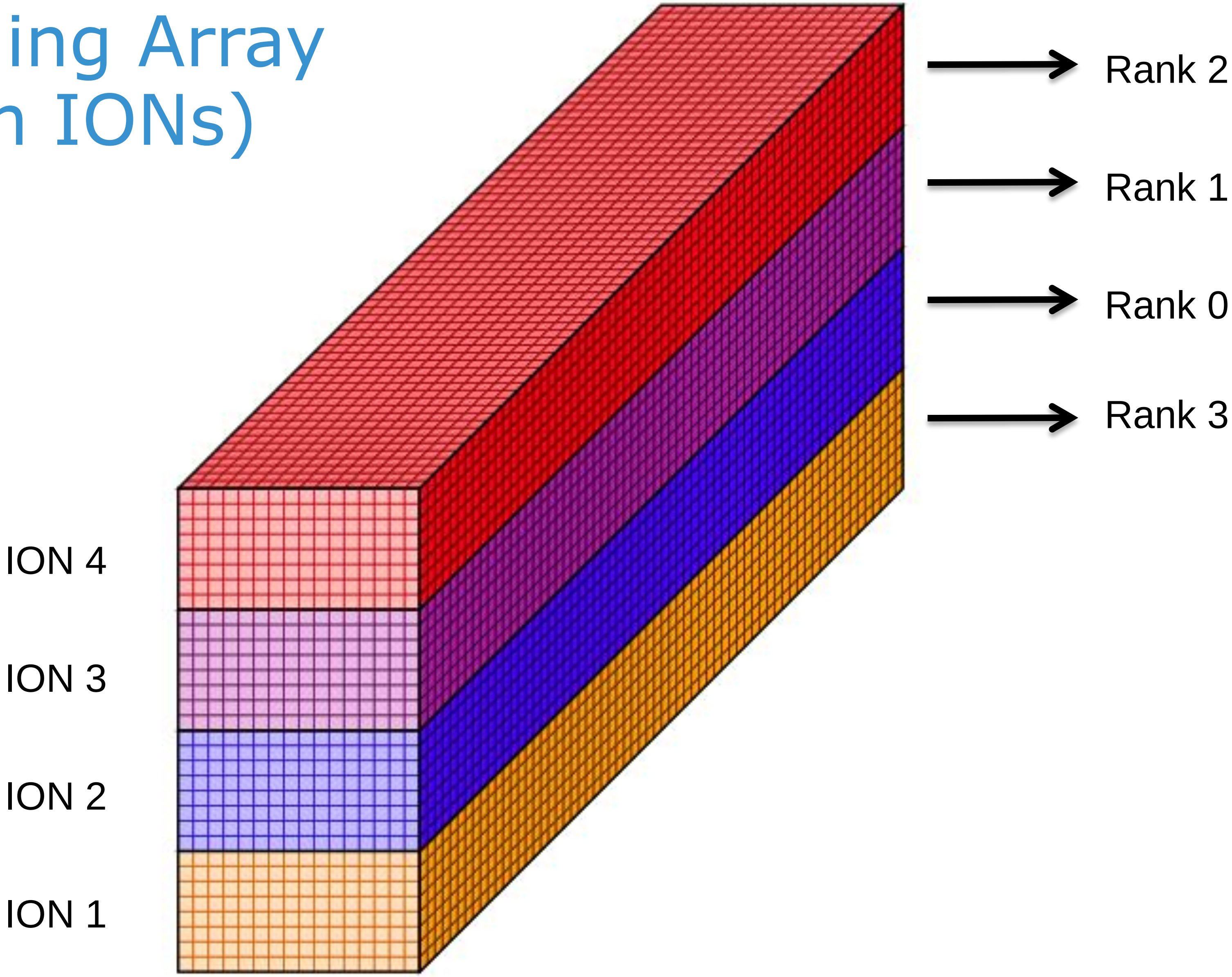
Shard7



Step 4.2: Read array (from IONs)

```
Running command: 1 read array_obj 0,0,0 8,8,8 2,4,8 8,8,8
Rank 0 ID 0: start[ 0,8,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 1 ID 0: start[ 0,16,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 2 ID 0: start[ 0,24,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 3 ID 0: start[ 0,0,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Call iod_array_read(), oh: 234, tid: 0x1
Rank 2 ID 0: iod_array_read() returns 0
Rank 1 ID 0: iod_array_read() returns 0
Rank 0 ID 0: iod_array_read() returns 0
Finish to read array - passed (rc = 0)
Rank 3 ID 0: iod_array_read() returns 0
```

Reading Array (from IONs)



Step 4.3/4.4: Purge Array / Query map

```
Running command: 1 purge array_obj
Call iod_obj_purge(), oh: 242, tid: 0x1...
Finish to purge object - passed (rc = 0)

Running command: 1 querymap array_obj
Call iod_obj_query_map(), tid: 0x1
Rank 0 in tid 0x1: dump IOD returned map:
obj_id            type      n_range
6000000171b6056d  ARRAY     0
Finish to query object map - passed (rc = 0)
```

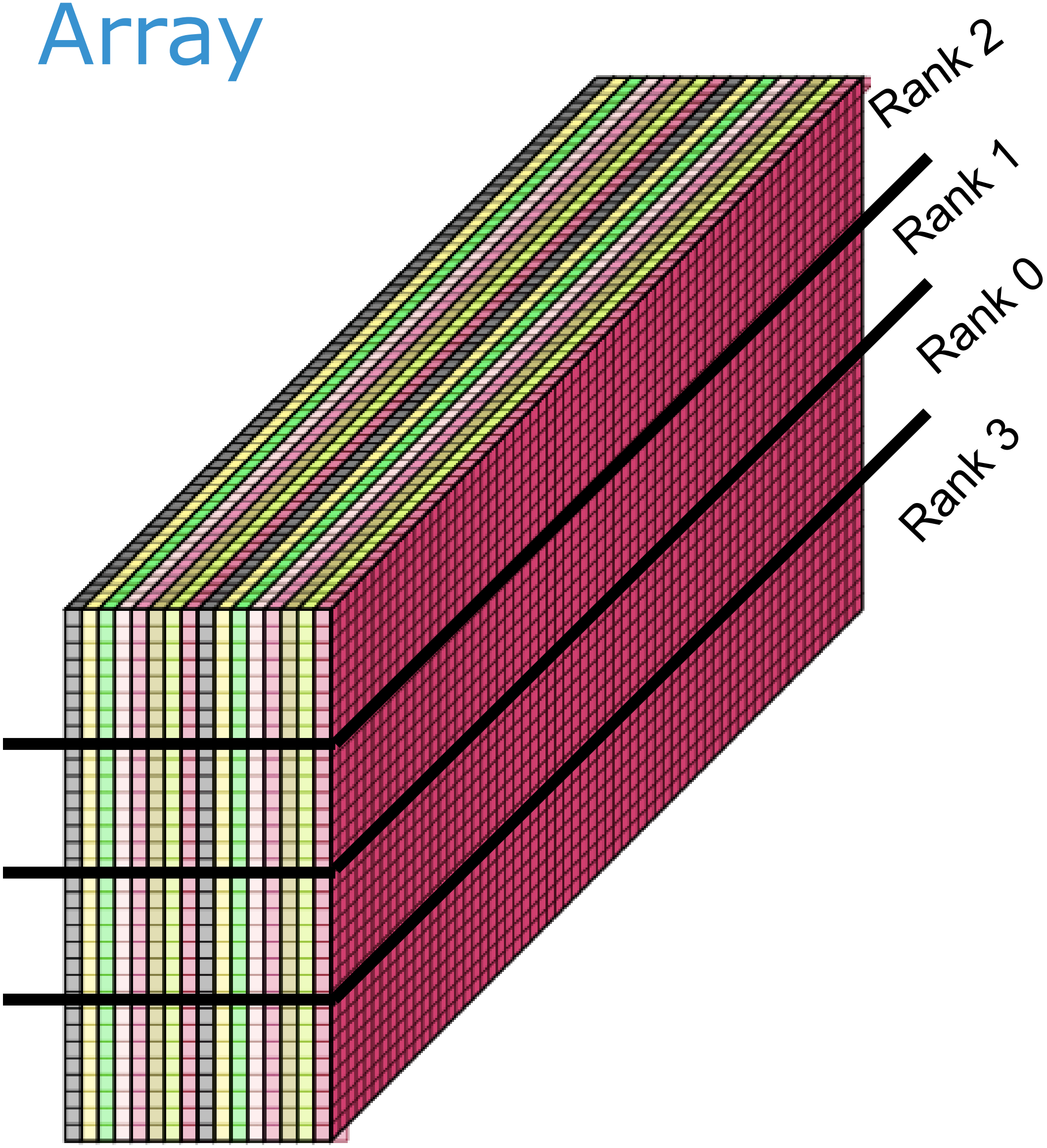
No data is IOD resident

```
# Verify data purged:
[root@lola-3 scripts]# plfs_query /tmp/iod_plfs/containerA/6000000110246979/1 \
           | grep dropping.data
[root@lola-3 scripts]#
```

Step 4.5: Read Array (from DAOS)

```
Running command: 1 read array_obj 0,0,0 8,8,8 2,4,8 8,8,8
Rank 0 ID 0: start[ 0,8,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 1 ID 0: start[ 0,16,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 2 ID 0: start[ 0,24,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 3 ID 0: start[ 0,0,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Call iod_array_read(), oh: 258, tid: 0x1
Rank 0 ID 0: iod_array_read() returns 0
Finish to read array - passed (rc = 0)
Rank 3 ID 0: iod_array_read() returns 0
Rank 1 ID 0: iod_array_read() returns 0
Rank 2 ID 0: iod_array_read() returns 0
```

Step 4.5: Read Array (from DAOS)



Step 5.1/5.2: Fetch Array into 2 replicas

```
# layout contains: location,type,target_start,target_num,strip_size,<dims_seq>
# location ------- "BB" (i.e. IOD_LOC_BB)
# type ----------- only support stripped layout(i.e.IOD_LAYOUT_STRIPED)
# target_start --- the beginning IOD
# target_num ----- the number of IODs. If 0, it defaults to all IODs
# stripe_size ---- resharding granularity. The number of cells for contiguous layout array
# dims_seq ------- For contiguous layout, it is an array with num_dims size
#
# ######## Step 5.1 - prefetch object 1st: using one IOD and default dims_seq
> Press enter to continue...

Running command: 1 fetch array_obj tag1 BB,striped,0,1,64,<>
Call iod_obj_fetch(), tid: 0x1...
Rank 0: check all information saved for fetch:
fake_tag  tag                location    type       target_start  target_num  stripe_size   dims_seq
tag1      0x6000000000000001  BB        striped     0            1           64           (nil)
Finish to fetch object - passed (rc = 0)

Running command: 1 fetch array_obj tag2 BB,striped,0,0,1024,<2,0,1>
Call iod_obj_fetch(), tid: 0x1...
Rank 0: check all information saved for fetch:
fake_tag  tag                location    type       target_start  target_num  stripe_size   dims_seq
tag1      0x6000000000000001  BB        striped     0            1           64           (nil)
tag2      0x6100000000000001  BB        striped     0            4           1024           2, 0, 1
Finish to fetch object - passed (rc = 0)
```

Step 5.3: Query Replica 1 Shards on IONs

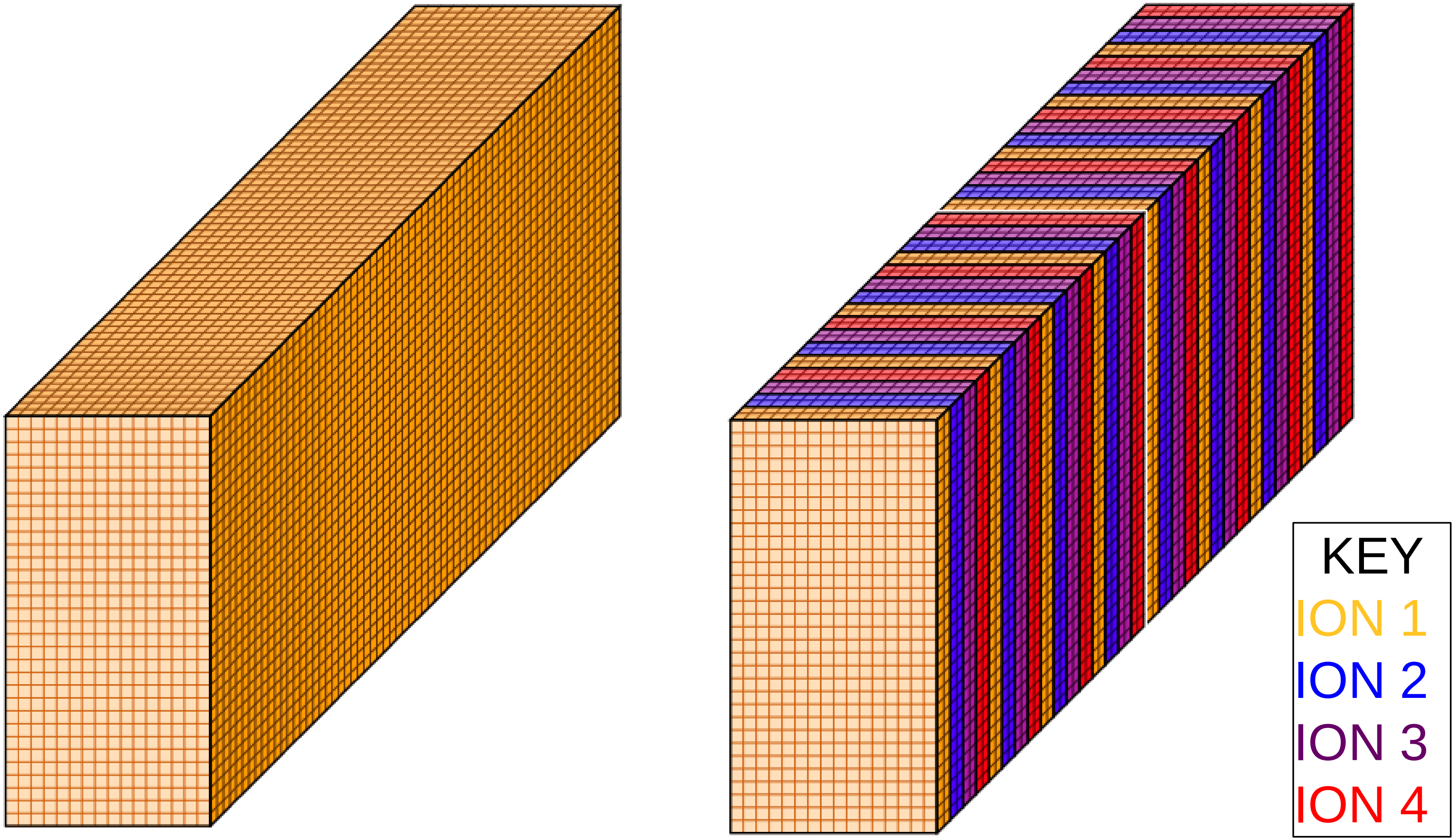
```
Running command: * querymap array_obj tag1
Call iod_obj_query_map(), tag: 0x6000000000000001
Rank 0 in tid 0x6000000000000001: dump IOD returned map:
obj_id            type      n_range
6000000171b6056d   ARRAY      1
range:   0, start:   0,  0,  0,  end:  15, 31, 63,  n_cell:  32768, loc: /mnt/lustre3/.plfs__shadow
Finish to query object map - passed (rc = 0)
```

Step 5.4: Query Replica 2 Shards on IONs

```
# ######## Step 5.4 - Query object's map: 2nd prefetched copy (should striped on all IODs)
> Press enter to continue...

Running command: * querymap array_obj tag2
Call iod_obj_query_map(), tag: 0x6100000000000001
Rank 0 in tid 0x6100000000000001: dump IOD returned map:
obj_id            type      n_range

6000000171b6056d   ARRAY     32
range:   0, start:   0,  0,  0,  end:  15, 31,  1,  n_cell:   1024, loc: /mnt/lustre1/.plfs__shadow
range:   1, start:   0,  0,  2,  end:  15, 31,  3,  n_cell:   1024, loc: /mnt/lustre2/.plfs__shadow
range:   2, start:   0,  0,  4,  end:  15, 31,  5,  n_cell:   1024, loc: /mnt/lustre3/.plfs__shadow
range:   3, start:   0,  0,  6,  end:  15, 31,  7,  n_cell:   1024, loc: /mnt/lustre4/.plfs__shadow
range:   4, start:   0,  0,  8,  end:  15, 31,  9,  n_cell:   1024, loc: /mnt/lustre1/.plfs__shadow
range:   5, start:   0,  0, 10,  end:  15, 31, 11,  n_cell:   1024, loc: /mnt/lustre2/.plfs__shadow
range:   6, start:   0,  0, 12,  end:  15, 31, 13,  n_cell:   1024, loc: /mnt/lustre3/.plfs__shadow
range:   7, start:   0,  0, 14,  end:  15, 31, 15,  n_cell:   1024, loc: /mnt/lustre4/.plfs__shadow
<snip>
range:  28, start:   0,  0, 56,  end:  15, 31, 57,  n_cell:   1024, loc: /mnt/lustre1/.plfs__shadow
range:  29, start:   0,  0, 58,  end:  15, 31, 59,  n_cell:   1024, loc: /mnt/lustre2/.plfs__shadow
range:  30, start:   0,  0, 60,  end:  15, 31, 61,  n_cell:   1024, loc: /mnt/lustre3/.plfs__shadow
range:  31, start:   0,  0, 62,  end:  15, 31, 63,  n_cell:   1024, loc: /mnt/lustre4/.plfs__shadow
Finish to query object map - passed (rc = 0)
```

Replica 1

Replica 2



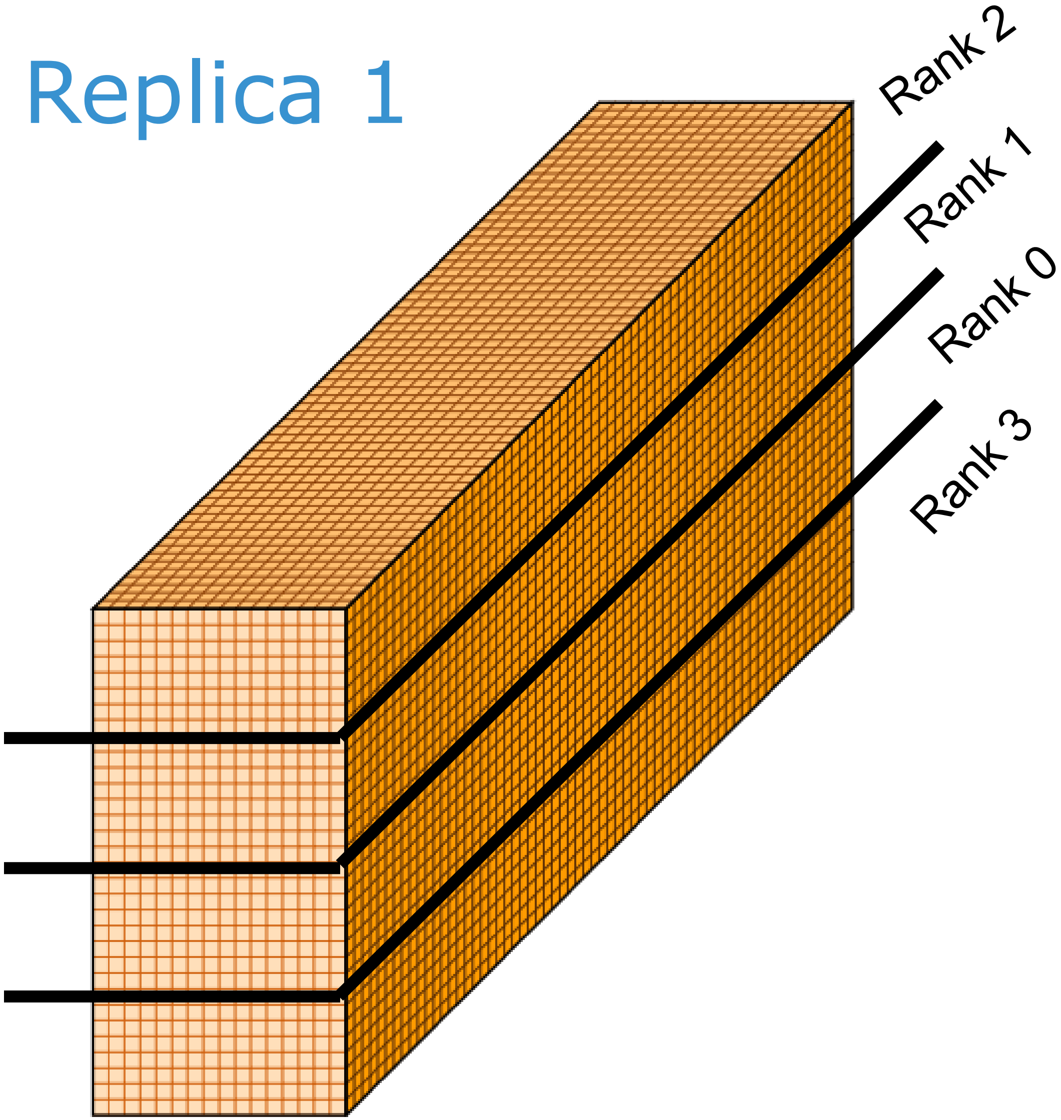
Step 5.5: Read Replica 1

```
# ######## Step 5.5 – read data of the 1st prefetched copy with its tag
Check prefetched copy of object array_obj(0x6000000171b6056d) at TAG = 0x6000000000000001
Rank 0 ID 0: start[ 0,8,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 1 ID 0: start[ 0,16,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 2 ID 0: start[ 0,24,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 3 ID 0: start[ 0,0,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Call iod_array_read(), oh: 330, tid: 0x6000000000000001
Rank 0 ID 0: iod_array_read() returns 0
Rank 0 ID 0: array IO data verification succeed
Finish to read array - passed (rc = 0)
Finish to readprefetched copy - passed (rc = 0)

Rank 2 ID 0: iod_array_read() returns 0
Rank 1 ID 0: iod_array_read() returns 0
Rank 3 ID 0: iod_array_read() returns 0
```

Step 5.6: Read Replica 2

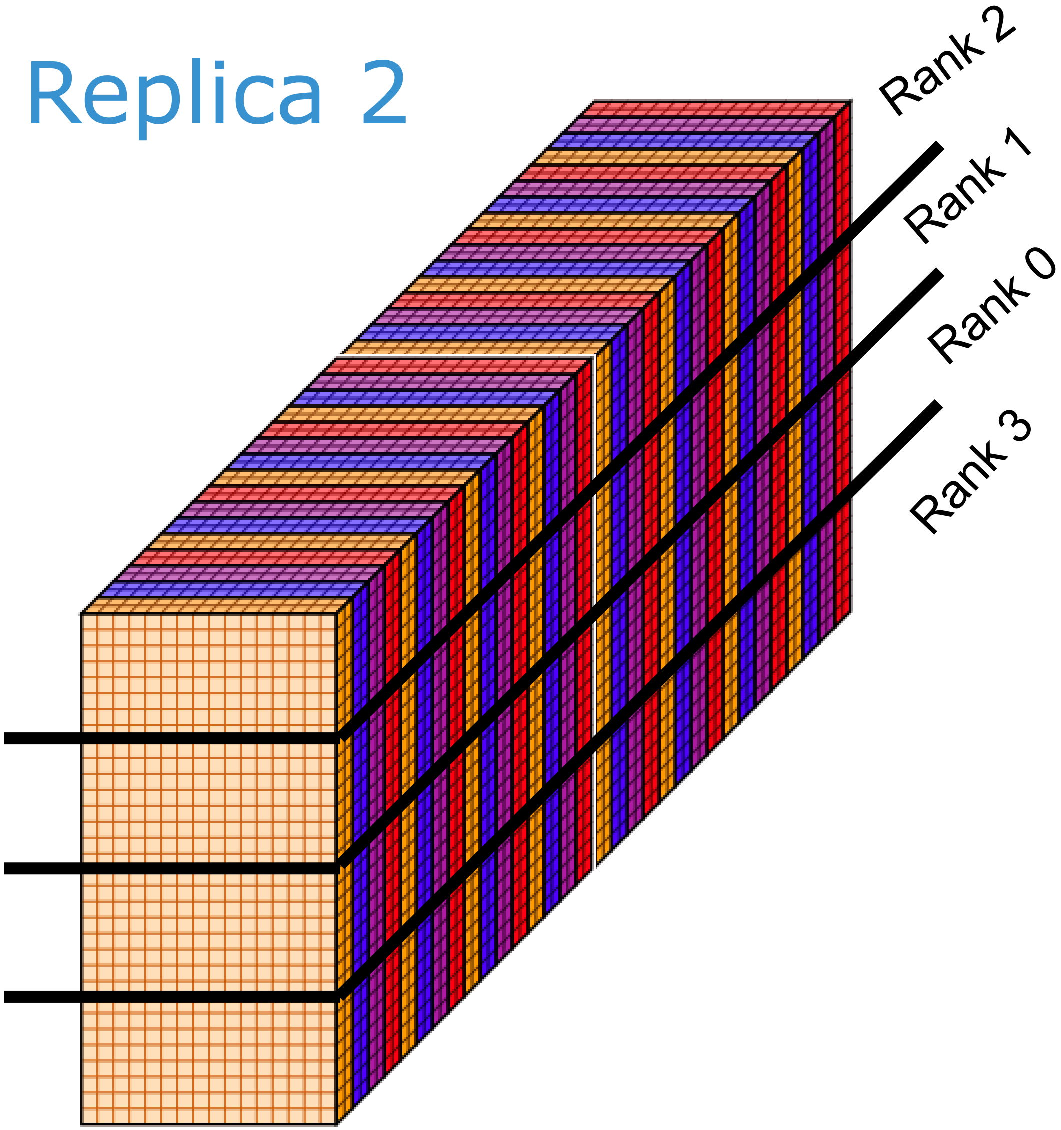
```
# ######## Step 5.6 – read data of the 2nd prefetched copy with its tag
Check prefetched copy of object array_obj(0x6000000171b6056d) at TAG = 0x6100000000000001
Rank 0 ID 0: start[ 0,8,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 1 ID 0: start[ 0,16,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 2 ID 0: start[ 0,24,0 ], stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Rank 3 ID 0: start[ 0,0,0 ],  stride[ 8,8,8 ], count[ 2,1,8 ], block[ 8,8,8 ]
Call iod_array_read(), oh: 338, tid: 0x6100000000000001
Rank 1 ID 0: iod_array_read() returns 0
Rank 2 ID 0: iod_array_read() returns 0
Rank 0 ID 0: iod_array_read() returns 0
Finish to read array - passed (rc = 0)
Finish to readprefetched copy - passed (rc = 0)
```

Reading Replica 1



KEY
ION 1
ION 2
ION 3
ION 4

Reading Replica 2



KEY

ION 1

ION 2

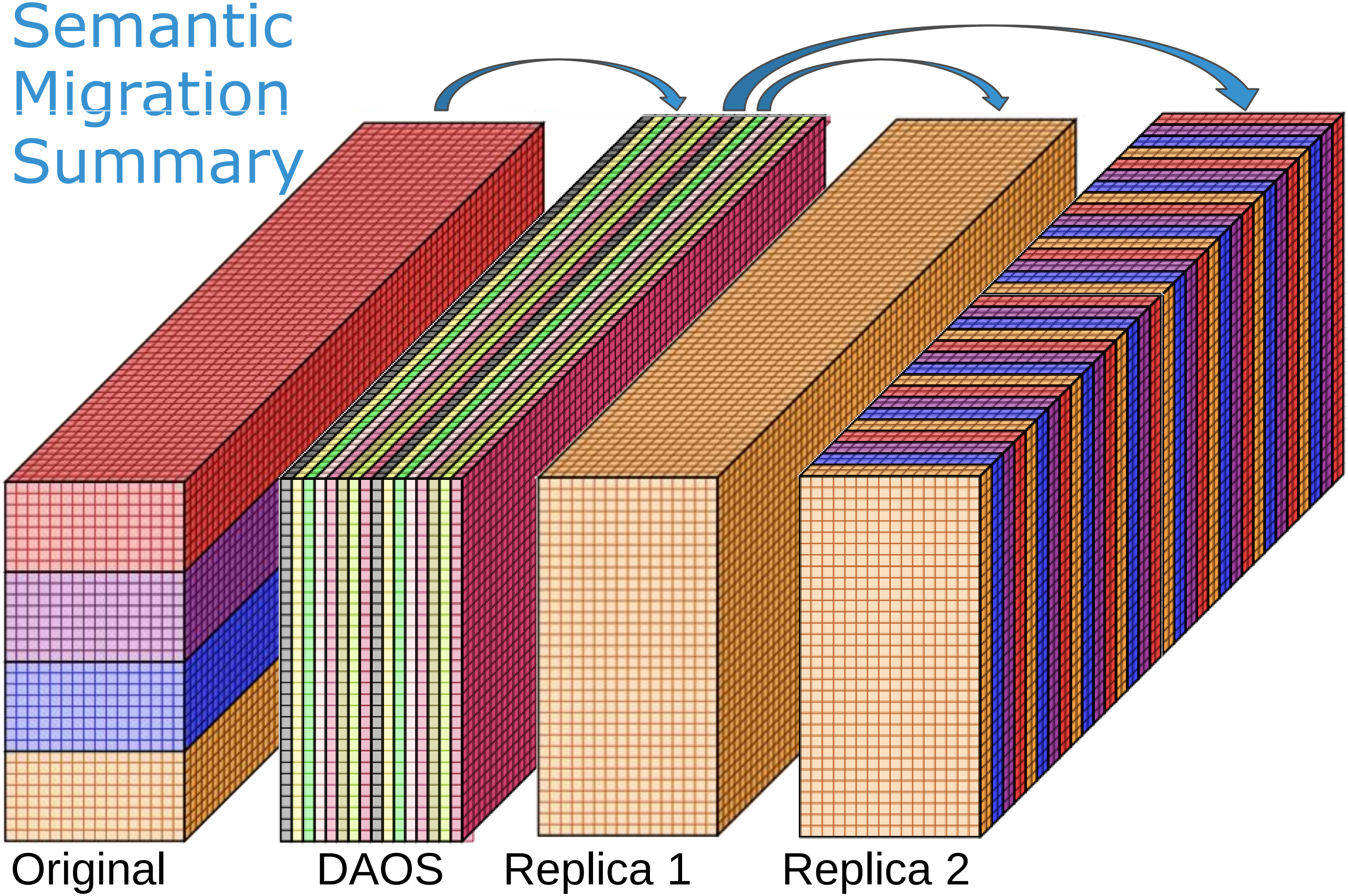
ION 3

ION 4

Step 5.7/6: Cleanup / Fini

```
# ######## Step 5.7 - finish TID1 for read
> Press enter to continue...

Running command: 1 transfinish normal
Call iod_trans_finish(), tid: 0x1, num_ranks: 0, flag: 0
Finish to finish transaction - passed (rc = 0)
# -----------------------------------------------------------------------
# ######## Step 6: close the container and quit.
> Press enter to continue...

Running command: * contclose
Call iod_container_close(), handle: 25...
Finish to close container - passed (rc = 0)
> Press enter to continue...

Running command: * quit

M7.5_case1_array_migration_ops: overall_result============= 0(Success)
M7.5_case1_array_migration_ops: overall_result============= 0(Success)
M7.5_case1_array_migration_ops: overall_result============= 0(Success)
M7.5_case1_array_migration_ops: overall_result============= 0(Success)
```

Semantic Migration Summary



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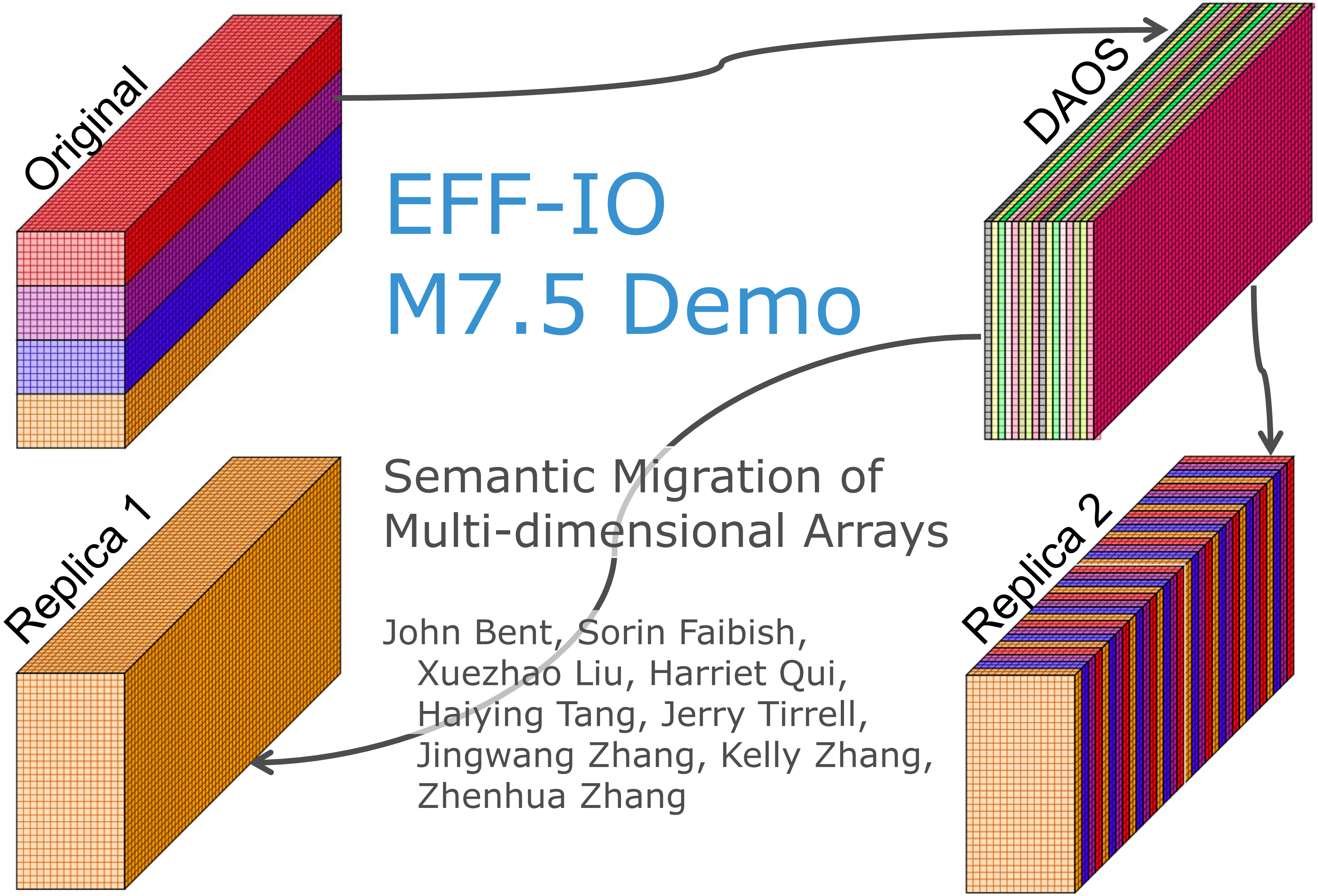
EFF-IO M7.5 Demo



Semantic Migration of Multi-dimensional Arrays

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