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Proposal

(More) Flexible RMA Synchronization for MPI-3

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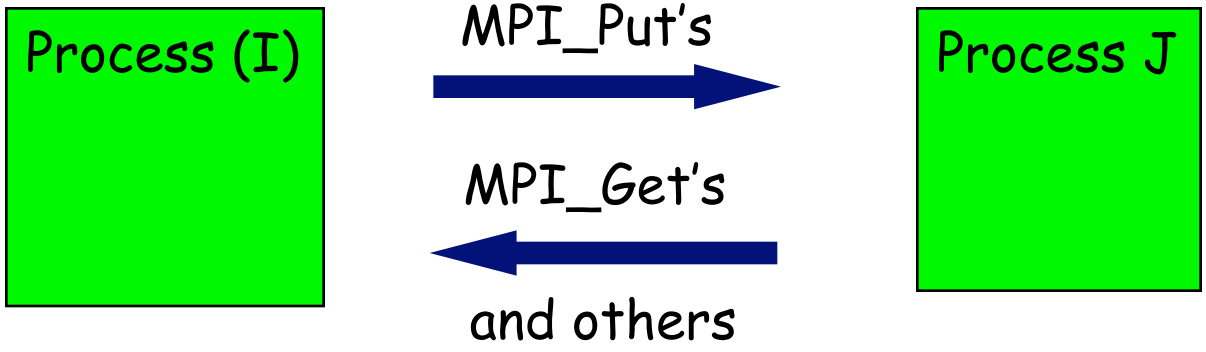
The Problem



How can **Process J** **decide** that **Process (I)** has finished RMA transfer so that **Process J** can access/change the data ?

MPI-2: Collective approach (Fence, Complete/Wait) on Windows

The group has to be clear in advance; not very flexible

New Proposal

Shared Memory: Atomic counters, ready flags, semaphores, …

It's not necessarily defined, which process provides the data, decrements the counter, sets the flag, …

Idea

Window:

Large amount of (shared) memory

Atomic counter (synchronization counters):

To independently handle parts of the (shared) memory

New MPI Type MPI_Sync: MPI Synchronization counter

Special Allocate:

MPI_Win_Sync_alloc_objects (n_sync, sync_counters, win, info)

MPI_Win_Sync_free_objects (n_sync, sync_counters, win)

to be performed by the owner of the window win

Problem

How to transfer the info on MPI_Sync counters

- Every process (in win comm) should be able to get access
- Access to counter may change in run-time
- Processes must have required info to ``attach'' to the counter

Idea:

- New MPI Datatype MPI_Handle_sync
- Transfer data via MPI pt2pt and collectives

Possible alternative : Create n_sync counters in MPI_Win_create

Pro: User doesn't see them; Contra: libraries, less flexibility, scalability

Usage

On processes which perform RMA operations

MPI_Win_sync_ops_init (target_rank, sync_mode, sync_counter, win, info, req)

Init

- wait for completion of RMA operations corresponding to
  sync_mode : Bit vector or of MPI_MODE_WIN_PUT, MPI_MODE_WIN_GET, MPI_MODE_WIN_ACCUMULATE
- increment/decrement counter sync_counter on process target_rank

Usage

On process where counter is located

MPI_Win_sync_object_init (sync_counter, count, win, info, req)

Init

- wait for count completions (atomic increments)

  of requests created by MPI_Win_sync_ops_init

Designed as persistent request for frequent re-use

- All possibilities of MPI Test/Wait functions
- Works on cache coherent and non cache coherent systems
- Can be implemented by pt2pt functions

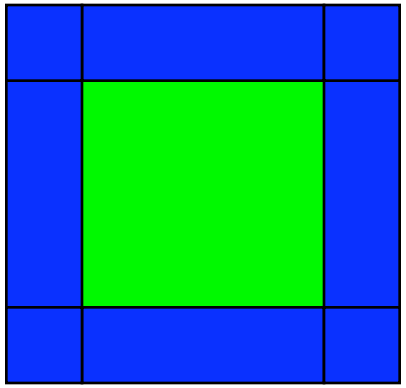
Example

Target

```
MPI_Win_sync_object_init (sync_counter,
        8, win, info, req);
MPI_Start (req)
```

8 neighbours

```
MPI_Win_sync_ops_init (target_rank
        MPI_MODE_PUT, sync_counter,
        win, info, req); MPI_Start (req)
```



MPI_Put (target, …)

MPI_Wait (req, …)

MPI_Wait (req, …)

Wait for completion of which RMA ops ?

With current MPI-2 Interface:

Wait for completion of all RMA requests

since last synchronization

Not really save programming style.

Difficult for threads or several counters

Additional functions for MPI-3 interface

(useful for threads and several synchronization counters)

Add synchronization counter request to RMA functions

for example:

MPI_Iput (…, win, req), MPI_Iget (…, win, req), …

Window as Shared Memory

More dynamic usage of window required

(for example for dynamic process spawning)

MPI_Win_change_comm (new_comm, peer_rank, win)

Allow processes to join or leave an already existing window.

Possible Extensions

Synchronization counters == atomic counters

- Wait/Test that counter completed on remote node
- Change final counter value (increment, decrement)

Automatic restart of request if

final counter value is reached and

test/wait function was executed