Messages


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Messages

- A message contains a number of elements of some particular datatype.
- MPI datatypes:
  - Basic types.
  - Derived types.
- Derived types can be built up from basic types.
- C types are different from Fortran types.

MPI Basic Datatypes - C

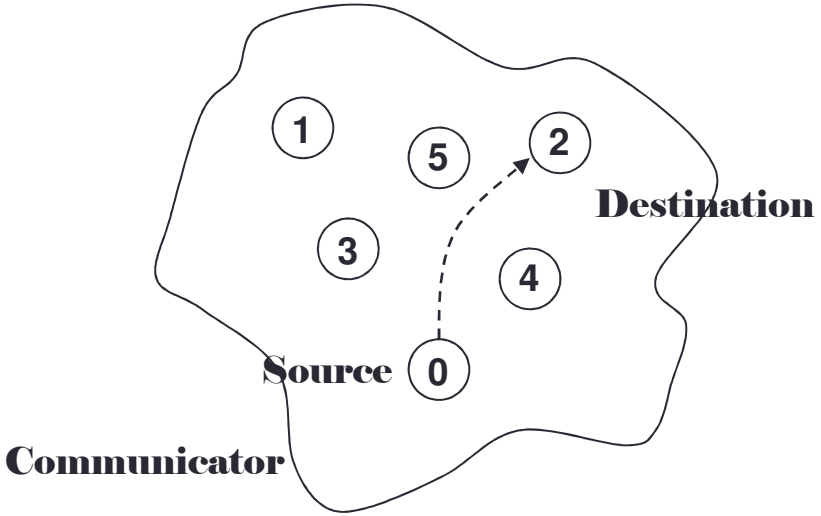
MPI Datatype	C datatype
MPI_CHAR	signed char
MPI_SHORT	signed short int
MPI_INT	signed int
MPI_LONG	signed long int
MPI_UNSIGNED_CHAR	unsigned char
MPI_UNSIGNED_SHORT	unsigned short int
MPI_UNSIGNED	unsigned int
MPI_UNSIGNED_LONG	unsigned long int
MPI_FLOAT	float
MPI_DOUBLE	double
MPI_LONG_DOUBLE	long double
MPI_BYTE	
MPI_PACKED	

MPI Basic Datatypes - Fortran

MPI Datatype	Fortran Datatype
MPI_INTEGER	INTEGER
MPI_REAL	REAL
MPI_DOUBLE_PRECISION	DOUBLE PRECISION
MPI_COMPLEX	COMPLEX
MPI_LOGICAL	LOGICAL
MPI_CHARACTER	CHARACTER(1)
MPI_BYTE	
MPI_PACKED	

Point-to-Point Communication

Point-to-Point Communication



- Communication between two processes.
- Source process sends message to destination process.
- Communication takes place within a communicator.
- Destination process is identified by its rank in the communicator.

Communication modes

Sender mode	Notes
Synchronous send	Only completes when the receive has completed.
Buffered send	Always completes (unless an error occurs), irrespective of receiver.
Standard send	Either synchronous or buffered.
Ready send	Always completes (unless an error occurs), irrespective of whether the receive has completed.
Receive	Completes when a message has arrived.

MPI Sender Modes

OPERATION	MPI CALL
Standard send	MPI_Send
Synchronous send	MPI_Ssend
Buffered send	MPI_Bsend
Ready send	MPI_Rsend
Receive	MPI_Recv

Sending a message

- C:

```
int MPI_Ssend(void *buf, int count,
              MPI_Datatype datatype,
              int dest,   int tag,
              MPI_Comm comm)
```

- Fortran:

```
      MPI_SSEND(BUF, COUNT, DATATYPE, DEST,
                TAG, COMM, IERROR)

     <type> BUF(*)
      INTEGER COUNT, DATATYPE, DEST, TAG
      INTEGER COMM, IERROR
```

Receiving a message

- C:

```
int MPI_Recv(void *buf, int count,
             MPI_Datatype datatype,
             int source, int tag,
             MPI_Comm comm, MPI_Status *status)
```

- Fortran:

```
MPI_RECV(BUF, COUNT, DATATYPE, SOURCE, TAG, COMM,
          STATUS, IERROR)

<type> BUF(*)
INTEGER COUNT, DATATYPE, SOURCE, TAG, COMM,
      STATUS(MPI_STATUS_SIZE), IERROR
```

Synchronous Blocking Message-Passing

- Processes synchronise.
- Sender process specifies the synchronous mode.
- Blocking both processes wait until the transaction has completed.

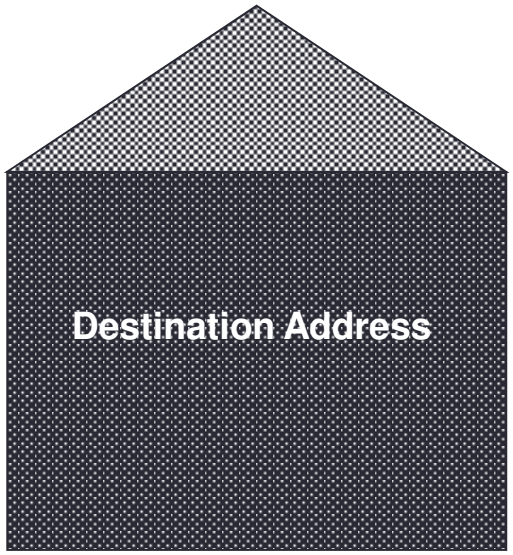
For a communication to succeed:

- Sender must specify a valid destination rank.
- Receiver must specify a valid source rank.
- The communicator must be the same.
- Tags must match.
- Message types must match.
- Receiver's buffer must be large enough.

Wildcarding

- Receiver can wildcard.
- To receive from any source `MPI_ANY_SOURCE`
- To receive with any tag `MPI_ANY_TAG`
- Actual source and tag are returned in the receiver's `status` parameter.

Communication Envelope



Senders Address

For the attention of:

Data

Item 1

Item 2

Item 3

Communication Envelope Information

- Envelope information is returned from `MPI_RECV` as `status`
- Information includes:
  - Source: `status.MPI_SOURCE` or `status(MPI_SOURCE)`
  - Tag: `status.MPI_TAG` or `status(MPI_TAG)`
  - Count: `MPI_Get_count` or `MPI_GET_COUNT`

Received Message Count

- C:

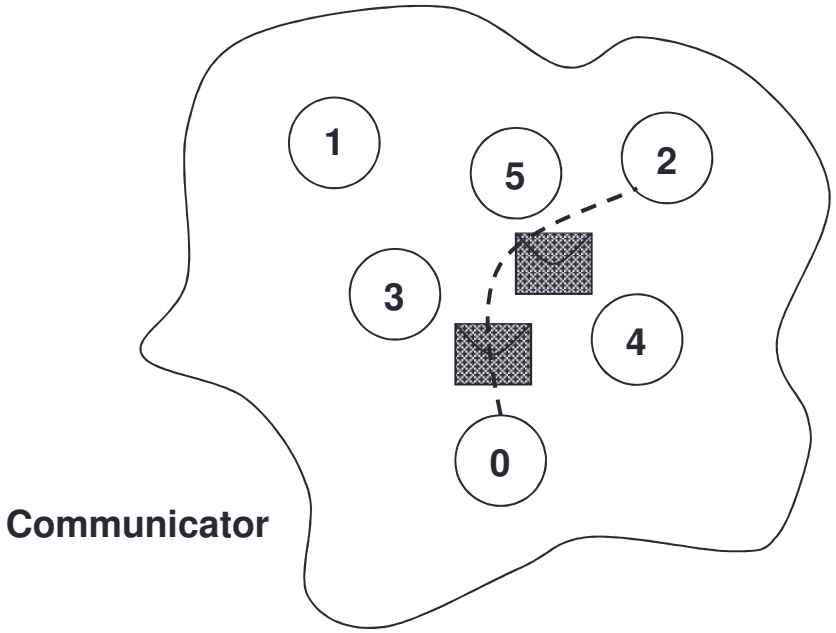
```
int MPI_Get_count(MPI_Status *status,
                  MPI_Datatype datatype,
                  int *count)
```

- Fortran:

```
MPI_GET_COUNT(STATUS, DATATYPE, COUNT,
      IERROR)

INTEGER STATUS(MPI_STATUS_SIZE), DATATYPE, COUNT,
IERROR
```

Message Order Preservation



- Messages do not overtake each other.
- This is true even for non-synchronous sends.

Exercise – Calculation of Pi

- See Exercise 2 on the exercise sheet
- Illustrates how to divide work based on rank
  - and how to send point-to-point messages in an SPMD code
- Notes:
  - the value of *N* in the expansion of pi is not the same as the number of processors
  - you should expect to write a program such as *N*=100 running on 4 processors
  - your code should be able to run on any number of processors
  - do not hard code the number of processors in your program!
- If you finish the pi example you may want to try Exercise 3 (ping-pong) but it is not essential

Timers

- C:

```
double MPI_Wtime(void);
```

- Fortran:

```
DOUBLE PRECISION MPI_WTIME()
```

- Time is measured in seconds.
- Time to perform a task is measured by consulting the timer before and after.
- Modify your program to measure its execution time and print it out.