

# Calcul Haute Performance

Abdoulaye SAMAKÉ \*

DER de Mathématiques et Informatique

Faculté des Sciences et Techniques (FST)

Université des Sciences, des Techniques et des Technologies de Bamako (USTTB)

**Master IRT - ITMA**

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\*. E-mail : [abdoulaye.samake@usttb.edu.ml](mailto:abdoulaye.samake@usttb.edu.ml)  
BP : E 3206, Bamako, Mali

# Outline

**1 Point to Point Communications**

**2 Collective communications**

## Blocking Send

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

- |   |    |
|---|----|
| <input type="checkbox"/> buf : initial address of send buffer (choice)                    | IN |
| <input type="checkbox"/> count : number of elements in send buffer (non-negative integer) | IN |
| <input type="checkbox"/> datatype : datatype of each send buffer element (handle)         | IN |
| <input type="checkbox"/> dest : rank of destination (integer)                             | IN |
| <input type="checkbox"/> tag : message tag (integer)                                      | IN |
| <input type="checkbox"/> comm : communicator (handle)                                     | IN |

## Blocking Receive

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

<input type="checkbox"/> buf : initial address of receive (choice)	OUT
<input type="checkbox"/> count : number of elements in receive buffer (non-negative integer)	IN
<input type="checkbox"/> datatype : datatype of each receive buffer element (handle)	IN
<input type="checkbox"/> source : rank of source or MPI_ANY_SOURCE (integer)	IN
<input type="checkbox"/> tag : message tag or MPI_ANY_TAG (integer)	IN
<input type="checkbox"/> comm : communicator (handle)	IN
<input type="checkbox"/> status : status object (status)	OUT

## Blocking Send-Receive

```
int MPI_Sendrecv(
    const void *sendbuf,
    int sendcount,
    MPI_Datatype sendtype,
    int dest,
    int sendtag,
    void *recvbuf,
    int recvcount,
    MPI_Datatype recvtype,
    int source,
    int recvtag,
    MPI_Comm comm,
    MPI_Status *status
)
```

- |   |    |
|---|----|
| <input type="checkbox"/> sendbuf : initial address of send (choice)                           | IN |
| <input type="checkbox"/> sendcount : number of elements in send buffer (non-negative integer) | IN |
| <input type="checkbox"/> sendtype : type of elements in send buffer (handle)                  | IN |
| <input type="checkbox"/> dest : rank of destination (integer)                                 | IN |
| <input type="checkbox"/> sendtag : send tag (integer)   | IN |

## Blocking Send-Receive (Cont)

<input type="checkbox"/> recvbuf : initial address receive (choice)	OUT
<input type="checkbox"/> recvcount : number of elements in receive buffer (non-negative integer)	IN
<input type="checkbox"/> recvtype : type of elements in receive buffer (handle)	IN
<input type="checkbox"/> source : rank of source or MPI_ANY_SOURCE (integer)	IN
<input type="checkbox"/> recvtag : receive tag or MPI_ANY_TAG (integer)	IN
<input type="checkbox"/> comm : communicator (handle)	IN
<input type="checkbox"/> status : status object (status)	OUT

## Blocking Send-Receive Replace

```
int MPI_Sendrecv_replace(
    void *buf,
    int count,
    MPI_Datatype datatype,
    int dest,
    int sendtag,
    int source,
    int recvtag,
    MPI_Comm comm,
    MPI_Status *status
)
```

<input type="checkbox"/> buf : initial address of send and receive (choice)	INOUT
<input type="checkbox"/> count : number of elements in send and receive buffer (non-negative integer)	IN
<input type="checkbox"/> datatype : type of elements in send and buffer (handle)	IN
<input type="checkbox"/> dest : rank of destination (integer)	IN
<input type="checkbox"/> sendtag : send message tag (integer)	IN
<input type="checkbox"/> source : rank of source or MPI_ANY_SOURCE (integer)	IN
<input type="checkbox"/> recvtag : receive message tag or MPI_ANY_TAG (integer)	IN
<input type="checkbox"/> comm : communicator (handle)	IN
<input type="checkbox"/> status : status object (status)	OUT

## C MPI Datatypes

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



## Global distribution

```
int MPI_Bcast(
    void *buffer,
    int count,
    MPI_Datatype datatype,
    int root,
    MPI_Comm comm
)
```

<input type="checkbox"/> buffer : starting address of buffer (choice)	INOUT
<input type="checkbox"/> count : number of entries in buffer (non-negative integer)	IN
<input type="checkbox"/> datatype : datatype of buffer (handle)	IN
<input type="checkbox"/> root : rank of broadcast root (integer)	IN
<input type="checkbox"/> comm : communicator (handle)	IN

## Selected distribution

```
int MPI_Scatter(
    const void *sendbuf,
    int sendcount,
    MPI_Datatype sendtype,
    void *recvbuf,
    int recvcount,
    MPI_Datatype recvtype,
    int root,
    MPI_Comm comm
)
```

- |   |     |
|---|-----|
| <input type="checkbox"/> sendbuf : address of send buffer (choice, significant only at root)                                  | IN  |
| <input type="checkbox"/> sendcount : number of elements sent to each process (non-negative integer, significant only at root) | IN  |
| <input type="checkbox"/> sendtype : datatype of send buffer elements (handle, significant only at root)                       | IN  |
| <input type="checkbox"/> recvbuf : address of receive buffer (choice)   | OUT |
| <input type="checkbox"/> recvcount : number of elements in receive buffer (non-negative integer)                              | IN  |
| <input type="checkbox"/> recvtype : datatype of receive buffer elements (handle)  | IN  |
| <input type="checkbox"/> root : rank of sending process (integer)   | IN  |
| <input type="checkbox"/> comm : communicator (handle)   | IN  |

## Collection

```
int MPI_Gather(
    const void *sendbuf,
    int sendcount,
    MPI_Datatype sendtype,
    void *recvbuf,
    int recvcnt,
    MPI_Datatype recvtype,
    int root,
    MPI_Comm comm
)
```

- |   |     |
|---|-----|
| <input type="checkbox"/> sendbuf : starting address of send buffer (choice)   | IN  |
| <input type="checkbox"/> sendcount : number of elements in send buffer (non-negative integer)                                 | IN  |
| <input type="checkbox"/> sendtype : datatype of send buffer elements (handle)   | IN  |
| <input type="checkbox"/> recvbuf : address of receive buffer (choice, significant only at root)                               | OUT |
| <input type="checkbox"/> recvcnt : number of elements for any single receive (non-negative integer, significant only at root) | IN  |
| <input type="checkbox"/> recvtype : datatype of recv buffer elements (handle, significant only at root)                       | IN  |
| <input type="checkbox"/> root : rank of receiving process (integer)   | IN  |
| <input type="checkbox"/> comm : communicator (handle)   | IN  |

## Collection to All

```
int MPI_Allgather(
    const void *sendbuf,
    int sendcount,
    MPI_Datatype sendtype,
    void *recvbuf,
    int recvcount,
    MPI_Datatype recvtype,
    int root,
    MPI_Comm comm
)
```

- |  |     |
|--|-----|
| <input type="checkbox"/> sendbuf : starting address of send buffer (choice)                              | IN  |
| <input type="checkbox"/> sendcount : number of elements in send buffer (non-negative integer)            | IN  |
| <input type="checkbox"/> sendtype : datatype of send buffer elements (handle)                            | IN  |
| <input type="checkbox"/> recvbuf : address of receive buffer (choice, significant only at root)          | OUT |
| <input type="checkbox"/> recvcount : number of elements received from any process (non-negative integer) | IN  |
| <input type="checkbox"/> recvtype : datatype of receive buffer elements (handle)                         | IN  |
| <input type="checkbox"/> comm : communicator (handle)  | IN  |

## Collection and distribution

```
int MPI_Alltoall(
    const void *sendbuf,
    int sendcount,
    MPI_Datatype sendtype,
    void *recvbuf,
    int rcvcount,
    MPI_Datatype rcvtype,
    MPI_Comm comm
)
```

- |   |     |
|---|-----|
| <input type="checkbox"/> sendbuf : starting address of send buffer (choice)                             | IN  |
| <input type="checkbox"/> sendcount : number of elements sent to each process (non-negative integer)     | IN  |
| <input type="checkbox"/> sendtype : datatype of send buffer elements (handle)                           | IN  |
| <input type="checkbox"/> recvbuf : address of receive buffer (choice, significant only at root)         | OUT |
| <input type="checkbox"/> rcvcount : number of elements received from any process (non-negative integer) | IN  |
| <input type="checkbox"/> rcvtype : datatype of receive buffer elements (handle)                         | IN  |
| <input type="checkbox"/> comm : communicator (handle)   | IN  |

## Distributed reduction

```
int MPI_Reduce(
    const void *sendbuf,
    void *recvbuf,
    int count,
    MPI_Datatype datatype,
    MPI_Op op,
    int root,
    MPI_Comm comm
)
```

- |   |     |
|---|-----|
| <input type="checkbox"/> sendbuf : address of send buffer (choice)                              | IN  |
| <input type="checkbox"/> recvbuf : address of receive buffer (choice, significant only at root) | OUT |
| <input type="checkbox"/> count : number of elements in send buffer (non-negative integer)       | IN  |
| <input type="checkbox"/> datatype : datatype of elements of send buffer (handle)                | IN  |
| <input type="checkbox"/> op : reduce operation (handle)   | IN  |
| <input type="checkbox"/> root : rank of root process (integer)                                  | IN  |
| <input type="checkbox"/> comm : communicator (handle)   | IN  |

## Distributed reduction to all

```
int MPI_Allreduce(
    const void *sendbuf,
    void *recvbuf,
    int count,
    MPI_Datatype datatype,
    MPI_Op op,
    MPI_Comm comm
)
```

- |   |     |
|---|-----|
| <input type="checkbox"/> sendbuf : starting address of send buffer (choice)               | IN  |
| <input type="checkbox"/> recvbuf : starting address of receive buffer (choice)            | OUT |
| <input type="checkbox"/> count : number of elements in send buffer (non-negative integer) | IN  |
| <input type="checkbox"/> datatype : datatype of elements of send buffer (handle)          | IN  |
| <input type="checkbox"/> op : operation (handle)  | IN  |
| <input type="checkbox"/> comm : communicator (handle)                                     | IN  |

## Reduction operations

Name	Operation
MPI_SUM	Sum of elements
MPI_PROD	Product of elements
MPI_MAX	Maximum of elements
MPI_MIN	Minimum of elements
MPI_MAXLOC	Maximum of elements and location
MPI_MINLOC	Minimum of elements and location
MPI_LAND	Logical AND
MPI_LOR	Logical OR
MPI_LXOR	Logical exclusive OR