```
MPI_IN_PLACE
MPI_ARGV_NULL
MPI_ARGVS_NULL
MPI_UNWEIGHTED
MPI_WEIGHTS_EMPTY
```

Advice to implementors. In Fortran the implementation of these special constants may require the use of language constructs that are outside the Fortran standard. Using special values for the constants (e.g., by defining them through `PARAMETER` statements) is not possible because an implementation cannot distinguish these values from valid data. Typically, these constants are implemented as predefined static variables (e.g., a variable in an MPI-declared `COMMON` block), relying on the fact that the target compiler passes data by address. Inside the subroutine, this address can be extracted by some mechanism outside the Fortran standard (e.g., by Fortran extensions or by implementing the function in C). (*End of advice to implementors.*)

2.5.5 Choice

MPI functions sometimes use arguments with a *choice* (or union) data type. Distinct calls to the same routine may pass by reference actual arguments of different types. The mechanism for providing such arguments will differ from language to language. For Fortran with the include file `mpif.h` or the `mpi` module, the document uses <type> to represent a choice variable; with the Fortran `mpi_f08` module, such arguments are declared with the Fortran 2008 + TR 29113 syntax `TYPE(*), DIMENSION(..)`; for C, we use `void *`.

Advice to implementors. Implementors can freely choose how to implement choice arguments in the `mpi` module, e.g., with a non-standard compiler-dependent method that has the quality of the call mechanism in the implicit Fortran interfaces, or with the method defined for the `mpi_f08` module. See details in Section 17.1.1. (*End of advice to implementors.*)

2.5.6 Absolute Addresses and Relative Address Displacements

#431

Some MPI procedures use *address* arguments that represent an absolute address in the calling program, or relative displacement arguments that represent differences of two absolute addresses. The datatype of such arguments is MPI_Aint in C and `INTEGER (KIND=` MPI_ADDRESS_KIND) in Fortran. These types must have the same width and encode address values in the same manner such that address values in one language may be passed directly to another language without conversion. There is the MPI constant MPI_BOTTOM to indicate the start of the address range. For retrieving absolute addresses or any calculation with absolute addresses, one should use the routines and functions provided in Section 4.1.5. Section 4.1.12 provides additional rules for the correct use of absolute addresses. For expressions with relative displacements or other usage without absolute addresses, intrinsic operators (e.g., `+`, `-`, `*`) can be used.

#421 first part. Other parts see next page and Chap.4

2.5.7 File Offsets

For I/O there is a need to give the size, displacement, and offset into a file. These quantities can easily be larger than 32 bits which can be the default size of a Fortran integer. To

2.6.4 Functions and Macros

An implementation is allowed to implement MPI_WTIME, MPI_WTICK, PMPI_WTIME, PMPI_WTICK, MPI_AINT_ADD, MPI_AINT_DIFF, PMPI_AINT_ADD, PMPI_AINT_DIFF, #421 and the handle-conversion functions (MPI_Group_f2c, etc.) in Section 17.2.4, and no others, as macros in C.

Advice to implementors. Implementors should document which routines are implemented as macros. (*End of advice to implementors.*)

Advice to users. If these routines are implemented as macros, they will not work with the MPI profiling interface. (*End of advice to users.*)

2.7 Processes

An MPI program consists of autonomous processes, executing their own code, in an MIMD style. The codes executed by each process need not be identical. The processes communicate via calls to MPI communication primitives. Typically, each process executes in its own address space, although shared-memory implementations of MPI are possible.

This document specifies the behavior of a parallel program assuming that only MPI calls are used. The interaction of an MPI program with other possible means of communication, I/O, and process management is not specified. Unless otherwise stated in the specification of the standard, MPI places no requirements on the result of its interaction with external mechanisms that provide similar or equivalent functionality. This includes, but is not limited to, interactions with external mechanisms for process control, shared and remote memory access, file system access and control, interprocess communication, process signaling, and terminal I/O. High quality implementations should strive to make the results of such interactions intuitive to users, and attempt to document restrictions where deemed necessary.

Advice to implementors. Implementations that support such additional mechanisms for functionality supported within MPI are expected to document how these interact with MPI. (*End of advice to implementors.*)

The interaction of MPI and threads is defined in Section 12.4.

2.8 Error Handling

MPI provides the user with reliable message transmission. A message sent is always received correctly, and the user does not need to check for transmission errors, time-outs, or other error conditions. In other words, MPI does not provide mechanisms for dealing with failures in the communication system. If the MPI implementation is built on an unreliable underlying mechanism, then it is the job of the implementor of the MPI subsystem to insulate the user from this unreliability, or to reflect unrecoverable errors as failures. Whenever possible, such failures will be reflected as errors in the relevant communication call. Similarly, MPI itself provides no mechanisms for handling processor failures.

Of course, MPI programs may still be erroneous. A *program error* can occur when an MPI call is made with an incorrect argument (non-existing destination in a send operation, buffer too small in a receive operation, etc.). This type of error would occur in