

## Assignment 8. MPI. Bandwidth measurement.

Write an MPI program in which two processes exchange messages, measure the time per exchange iteration, and determine the dependence of the exchange time on the message length. Determine the latency and maximum achievable bandwidth of the communication network. Print the message length in bytes and the throughput in MB/s to the console. Change the length of the message in a loop starting from 1 element and increase to 1,000,000 elements, increasing by 10 times at each iteration.

Bandwidth measurement technique:

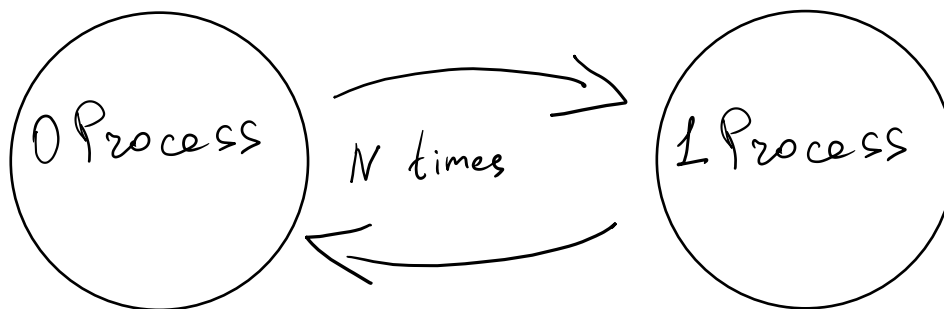
The following technique is used to measure point-to-point bandwidth. Process 0 sends a message of length L bytes to process 1.

**L = number of elements \* length in bytes of data type**

For example:

`L = 100 * sizeof(int);`

Process 1, having received a message from process 0, sends it a reply message of the same length. Blocking MPI calls are used (MPI\_Send, MPI\_Recv). These actions are repeated N = 10 times in order to minimize the error due to averaging. Process 0 measures the time T taken for all these exchanges.



The bandwidth R is determined by the formula:

$$R = \frac{2NL}{T}$$

Latency measurement technique:

Latency is measured as the time it takes to transmit a signal or message of zero length. At the same time, to reduce the influence of the error and low resolution of the system timer, it is important to repeat the operation of sending a signal and receiving a response a large number of times. Thus, if the time for N iterations of sending zero-length messages back and forth was T sec., Then the latency is measured as:

$$s = \frac{T}{2N}$$