Scientific Computing and Machine Learning on Multi- and Manycore Architectures Exercise 6

林澤佑
Tse-Yu Lin

D06946003@ntu.edu.tw

Data Science Degree Program

Analysis

In this exercise, we are asked to test the bandwidth of MPI. The program of this exercise was coded by modifying the ping-pong example provided in the course.

For the first batch of figures, the first one shows the relation of bandwith and message size with size 16, 32, 64, 128, 256 ,512 KB, and 1, 2, 4, 8, 16, 25, 32 MB. In the second figure, we further test with size 64, 512, and 1, 1.5, 1.9, and 2 GB. Note that once the size of message over 2 GB. It returns fail.

Bandwidth with respect to message size is plotted on the second batch, where the messgae size are the same as in the first batch of figures.

First batch show that there is a linear relation between message size and bandwidth. Even if the message size is enlarged, such linearity is still preserved.

Second batch show that the bandwidth is not uniform when message size is small (< 5 MB). The reason is, when the program runs, its computational time is related to probelm size plus a fixed communication time between nodes. Therefore, when message size getting larger, the communication time becomes negligible.

On the other hand, as the size is small, the communication time between nodes is not small compared with the computational time related to the message size. This is the reason we have non-steady line in the second batch of figures.

Run the code

The size of the message size can be found and modified in 22 line of the file ex6.c as shown below.

```
#define SIZE   1024*1024*1024
```

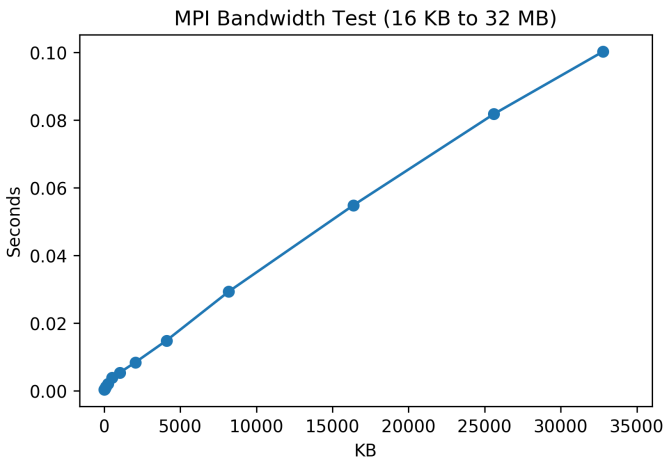
Note that 1024 bytes = 1 KB, $1024 * 1024 = 1,048,576$ bytes = 1 MB, and 1024^3 bytes $= 1,073,741,824 = 1$ GB. Hence, this SIZE can not exceed 2 GB. That is, no more than $2,147,483,648 - 1$ bytes.

Use the following command to compile the code (if necessary):

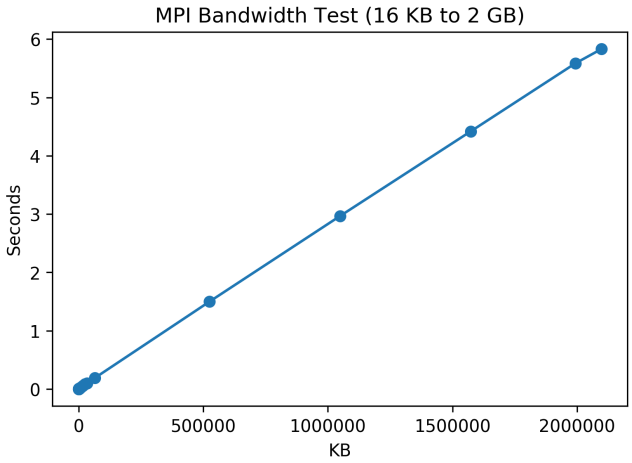
```
mpicc ex6_loop.c -o ex6_loop
```

and run this code by:

```
mpirun -np 2 ./ex6_loop
```

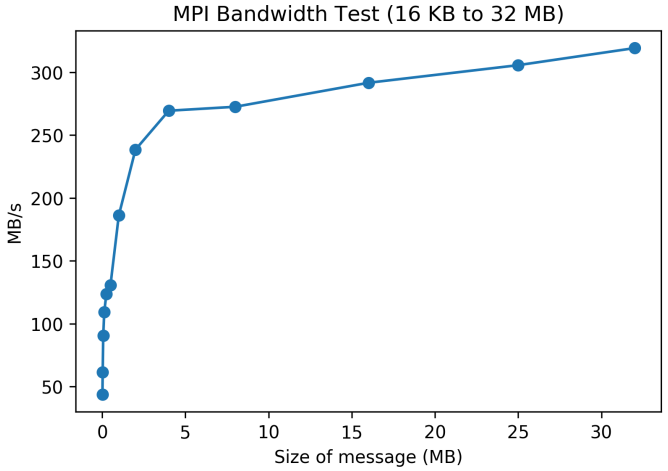


(a) From 16 KB to 32 MB.

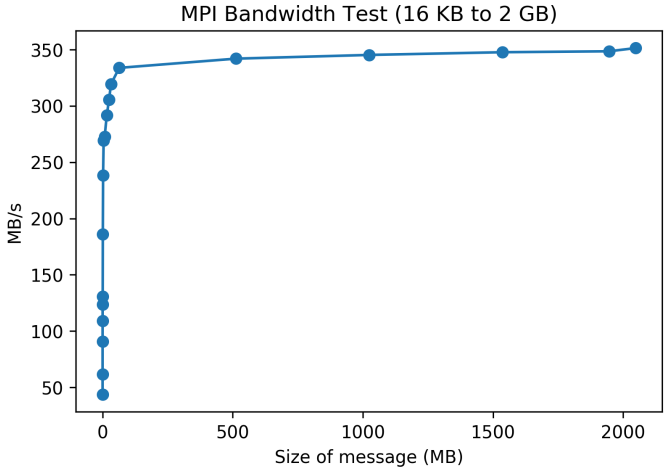


(b) From 16 KB to 2 GB.

Figure 1: MPI Bandwidth Test: size v.s. time



(a) From 16 KB to 32 MB.



(b) From 16 KB to 2 GB.

Figure 2: MPI Bandwidth Test: size v.s. bandwidth