Cost of some MPI routines

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Plan

Cost of MPI routines

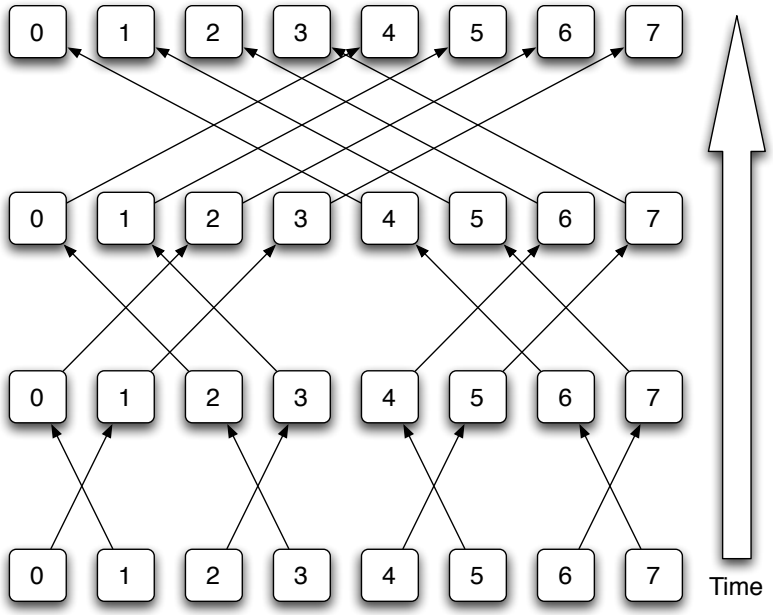
Cost of MPI routines, based on [Thakur et al., 2005]

Point-to-point communication (Send, Recv of a message of n words)

$$\alpha + n\beta$$

MPI_Allgather: n/P data from each process gathered on all processes cost based on recursive doubling algorithm (exchange n/P, $2n/P$, up to $2^{logP-1}n/P$ data in the last step):

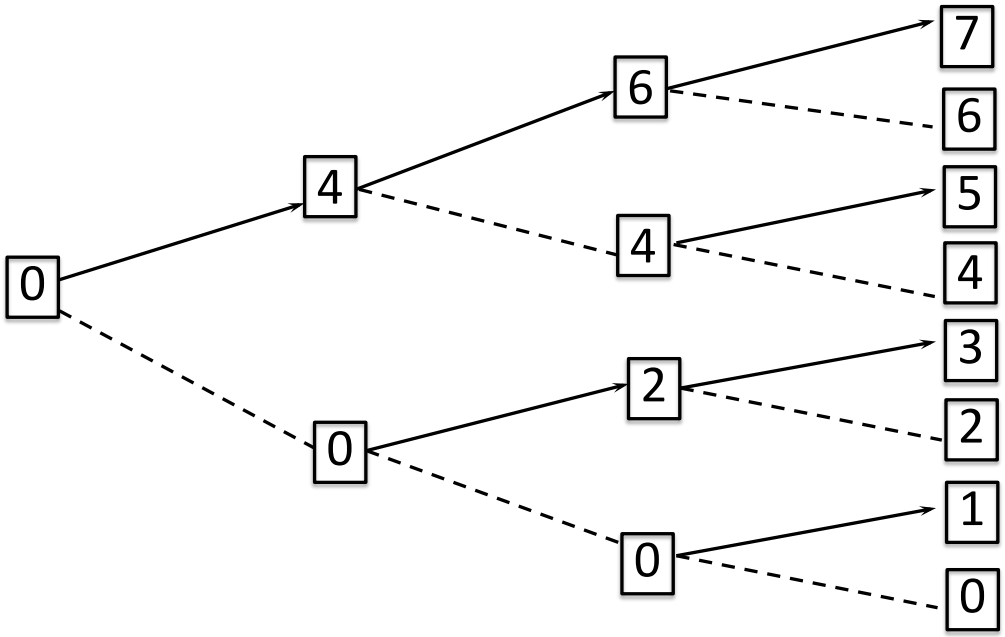
$$\log P\alpha + \frac{P-1}{P}n\beta$$



Cost of MPI routines (contd)

MPI_Broadcast: broadcasts n words from root to all processes, based on the binomial tree algorithm: First step, root sends data to (root + P/2); continue recursively with root and (root + P/2) as new roots.

$$\log P(\alpha + n\beta)$$



Cost of MPI routines (contd)

MPI_Alltoall: each process sends unique n/P data to every other process. For long messages, pairwise exchange algorithm with (P-1) steps:

$$(P-1)\alpha + n\beta$$

MPI_Reduce: a global reduction operation on n words of data, returns the result on the root. For short messages, reduction based on a binomial tree:

$$\log P(\alpha + n\beta + n\gamma)$$

MPI_Allreduce: a global reduction operation on n words of data, returns the result on all processors. For short messages, similar to the recursive doubling algorithm used in MPI_Allgather.

References (1)

Thakur, R., Rabenseifner, R., and Gropp, W. (2005).
Optimization of collective communication operations in mpich.
International Journal of High Performance Computing Applications, 19(1):49–66.