PARALLEL SOFTWARE TECHNOLOGIES LABORATORY PSTL

Research in the Parallel Software Technologies Laboratory

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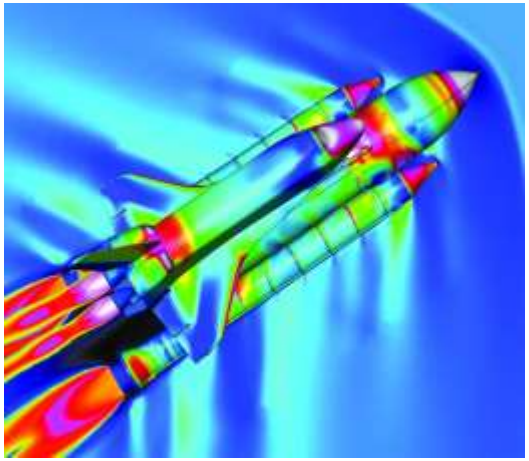
Motivation

- Why Parallel Computing?
  - Solve larger problems
  - Reduce the time to solution



How to use multiple processors

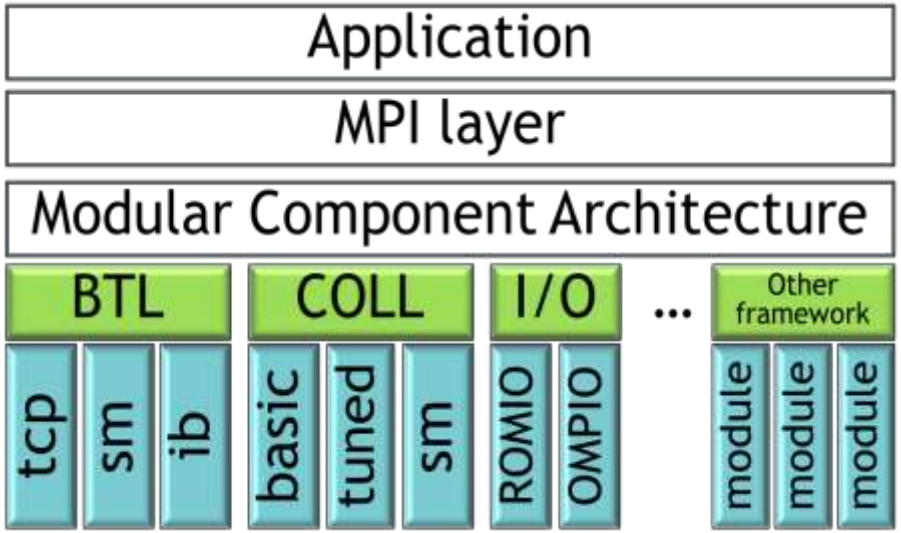
- **Functional parallelism**: each processor executes a different function
- **Data parallelism**: each processor executes the same function using a different portion of the overall problem

Portion of image on core 0

Portion of image on core 1

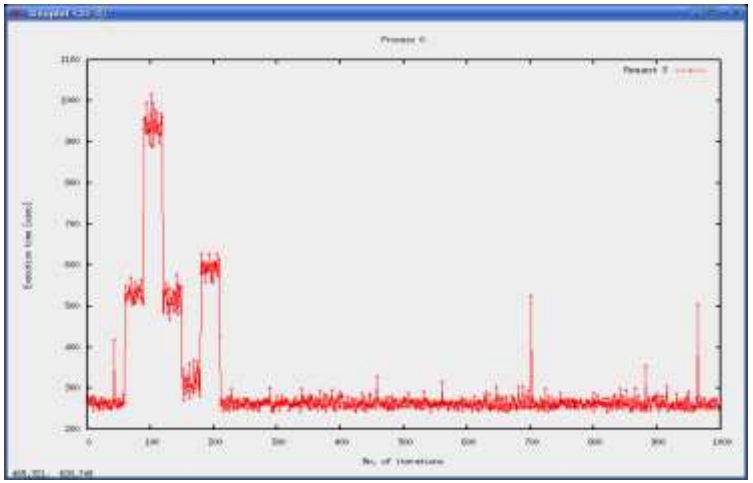
Open MPI

- Widely utilized public domain implementation of the Message Passing Interface (MPI)
- Jointly developed and maintained by numerous universities, research labs and companies



Abstract Data and Communication Library

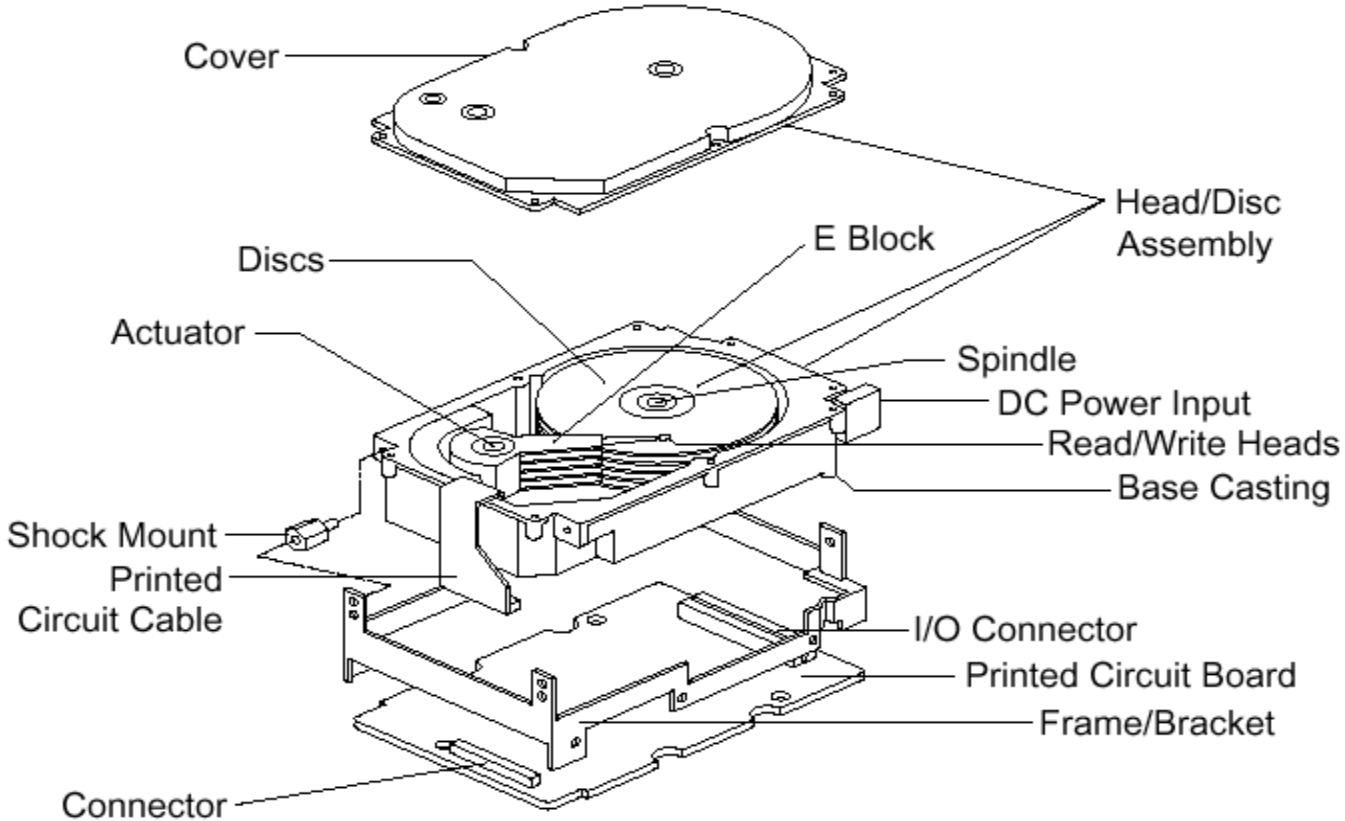
- Auto-tuning of (collective) communication operations
  - Library of possible algorithms / implementations
- Runtime selection logic through
  - Brute force search
  - Orthogonal search
  - 2k factorial design search
- Historic learning
  - Incorporating knowledge of previous executions
- Support for asynchronous operations through timer-object



The I/O problem

Magnetic Hard Drive:

- Latency to access data on disk: 7-12 ms
- Bandwidth: 5 – 100 MB/sec



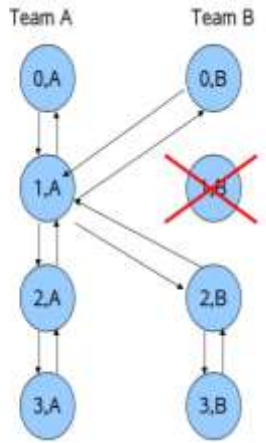
I/O projects at PSTL

- OMPIO
  - Efficient access to a shared file by multiple processes
  - Part of the 1.7 release series of Open MPI

- OpenMP I/O
  - Efficient access to a shared file by multiple threads
  - Integrated with the OpenUH compiler

Reliability in parallel computing

- Why worry about failures in parallel computing?
  - Increasing numbers of processors used
  - Unreliability of distributed environments



- Volpex: Parallel applications in volatile environments
  - Volpex Dataspace API
  - VolpexMPI

- Failure Management
  - Multiple copies of every processes
  - Independent process checkpoint/recovery
  - Message logging