Goal: a portable and high-performance UPC implementation
- Fully compliant with UPC 1.2 spec.
- Many extensions for performance and programmability
  - Non-blocking memcpy functions
  - Semaphores for one-side comm.
  - Fine granularity timers
- Entirely open source
- Windows/Mac/UNIX CD available at UPC booth

Multi-layer design, platform independent code generation
- Supports large-scale multiprocessors, SMPs and clusters
  - x86, Itanium, Opteron, Athlon, Alpha, PowerPC, MIPS, PA-RISC, SPARC, T3E, X1, SX-6, XT3(new), Blue Gene(new)

Well-documented interface
- Supports multiple UPC compilers (Berkeley UPC and Intrepid GCC/UPC)
- Etnus TotalView debugger support
- Communication tracing support
- Provides app interoperability:
  - UPC calls to/from C, C++, Fortran, MPI
  - Berkeley GASNet used for communication:
    - Portability from layered design
    - Performance from inline functions, macros, and network-specific implementations
    - Support SMP, Myrinet, Quadrics Elan 3/4, Infiniband, IBM LAPI, Dolphin SCI, MPI, Ethernet, X1/Altix shmem
  - Berkeley UPC Compiler
  - Portable Design
  - Translator
    - UPC Code
    - Translator Generated C Code
    - Berkeley UPC Runtime System
    - GASNet Communication System
    - Network Hardware

Overview

UPC-to-C Translator
- Based on Open64
- Translate UPC into C with calls to runtime
- High-level representation to get good serial performance
- Platform for experimenting with UPC optimizations:
  - Removes runtime branch from upc_forall loops
  - Privatize array accesses that must be local by analyzing affinity exp.
  - Works for affine cyclic/indefinite arrays

upc_forall Loop Optimization

PRE & Split-Phase Access
- PRE on shared expressions (ptr add, load, and store)
- Split-phase comm. – moves read initiations up, write completions down
- Coalesces fine-grained accesses to same struct/array

Runtime + GASNet

Average of Opt Speedup

Performance improvements for fine-grained benchmarks

VM-based Communication Overlap
- VM support for demand-driven comm. synchronization
- Message decomposition and scheduling for bulk comm.

Performance of Demand-Driven Synchronization (DDS)

Berkeley UPC Compiler
http://upc.lbl.gov