UPC at NERSC/LBNL

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Overview of NERSC Effort

Three components:

1) Compilers
   - Portable compiler infrastructure (UPC->C)
   - Explore optimizations: communication, shared pointers
   - Transfer technology to other UPC compilers

2) Runtime systems for multiple compilers
   - Allow use by other languages (Titanium and CAF)
   - And in other UPC compilers, e.g., Intrepid
   - Performance evaluation: influence machine vendors

3) Applications and benchmarks
   - Currently looking at NAS PB
   - Evaluating language and compilers
   - Plan to do a larger application next year
NERSC UPC Compiler

- Personnel
  - Costin Iancu
  - Wei Chen is starting this summer
- Funded by DOE/UPC

- Complementary to Intrepid effort
  - Intrepid
    - gcc-based compiler will generate assembly
    - Probably better serial performance
  - NERSC compiler
    - Open64 using C backends (currently)
    - Easier to port
    - Better framework for high level optimizations
Portable Runtime Support

- Developing a runtime layer that can be easily ported \textit{and} tuned to multiple architectures.

\begin{itemize}
  \item \textbf{GASNet Core API:} Small interface based on "Active Messages"
  \item \textbf{GASNet Extended API:} Supports put, get, locks, barrier, bulk, scatter/gather
  \item \textbf{Runtime:} Global pointers (opaque type with rich set of pointer operations), memory management, job startup, etc.
  \item Generic support for UPC, CAF, Titanium
  \item Direct implementations of parts of full GASNet
\end{itemize}
Runtime and GASNet

• Personnel
  - Dan Bonachea – Specification and reference implementation of GASNet, Dolphin
  - Jason Duell – Quadrics and reference runtime
  - Mike Welcome – IBM SP
  - Christian Bell – Myrinet
  - Paul Hargrove – VIA, Infiniband, etc.

• Funding
  - NSA: PC Clusters (Quadrics and Myrinet, VIA,…)
  - UPC/DOE: IBM SP, Quadrics/Compaq
  - PModels/DOE: GASNet spec and MPI implementation, generality (CAF, Ti), language/library extensions (I/O, collectives,…)
End to End Latency Over Time

- Latency has not improved significantly
  - T3E (shmem) was lowest point
**Send Overhead Over Time**

- Overhead has not improved significantly; T3D was best
  - Lack of integration; lack of attention in software
Applications Approach

• Requirements for Applications outside UPC group
  - At least one very good compiler
  - Portability
• Our strategy
  - Evaluate compilers to identify performance programming
  - Focus on medium-sized application/benchmarks this year
• Longer term, identify large application

• Personnel: Parry Husbands
• Funding: DOE/UPC
Agenda

• 9:00 Coffee and pastries
• 9:30 Overview of UPC work at LBNL - Kathy Yelick
• 9:45 UPC Compiler - Costin Iancu
• 10:15 Communication Optimizations (Titanium) - Jimmy Su
• 10:30 Memory Models (Titanium experience) - Wei Chen
• 10:45 Break
• 11:15 Benchmarking communication layers - Mike Welcome
• 12:00 Lunch
• 1:30 GASNet - Dan Bonachea
• 2:30 UPC Runtime - Jason Duell
• 3:15 Break
• 3:30 Infiniband - Paul Hargrove
• 4:00 Applications - Parry Husbands and Kathy Yelick