Numerical Libraries Project
Microsoft Incubation Group

Charles Fu
Microsoft Corporation

CSCADS Workshop
July 8, 2008
Many-Core Collaboration

• Microsoft effort to realize the performance of many-core architectures in their products
• Widespread internal and external projects to produce complete parallel programming software solution to customers
Numerical Libraries Project

- Project in Incubation Group starting Jan, 2008
- Investigate numerical libraries for single node many-core architectures
  - Develop an initial parallel numerical library specifically for Microsoft platforms
  - Demonstrate use of library in parallel applications
  - Contribute to adoption of Microsoft platforms on future many-core and HPC architectures
Tasks

- Investigate small set of functionality
- Implement routines for Microsoft platform
- Consider design of interfaces
- Analyze performance
Functional Areas

• Investigate “core” math functions
• Initially target dense and sparse linear algebra
• Will be looking at other areas
  – Graph algorithms
  – Random number generators
  – FFTs
• Applications drive priority of routines to implement
Implementation

- Implement libraries for Microsoft platforms
- Write versions for native and managed code
  - Native: C++
  - Managed: C#
- Evaluate parallel programming models
Interfaces

• Investigate the design of managed code interfaces
  – “Expert” interfaces allow users to access all algorithmic and performance parameters
  – “Productivity” interfaces allow users to ignore low level details
Performance

• Analyze performance of library routines
  – Scaling performance of algorithms
  – Performance of native vs. managed code
  – Performance of programming models

• Demonstrate performance of libraries in applications
Challenges

• Scalable performance on range of many-core architectures
  – Varying number of cores, memory bandwidth, layout, etc.
  – Successive generations of hardware
  – Small and large input sizes

• Target Microsoft software environments
  – Existing libraries and parallel applications written in native code
  – Libraries for Microsoft’s managed code environments may have security requirements which impact performance
  – Potentially mixing programming models within one application
Collaborations

• Within Microsoft
  – Evaluate early releases of programming models and runtime
  – Gather application requirements and plan demonstrations

• Research groups in academia
  – Share new many-core parallel algorithm ideas
  – UTK, Berkeley, and looking for others
Thank you!