Multi-Core + Multi-Tasking = Multi-Opportunity?

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Overview

- Background
- Motivation
- Industry Trends
- Technical Activity
- Market Opportunity
- Questions and Answers

Background

- **Large Integers**
  - Personal Fascination
    - Perfect numbers
    - Mersenne primes
    - Fibonacci sequences
  - Implementations
    - BASIC, FORTRAN, Pascal, PL/I, Gypsy, C, Ada
- **Computer Security**
  - DES Algorithm
  - RSA Factoring

Initial Motivation

- **RSA Factoring Challenge (now withdrawn)**
  - Determine prime factors of large integers
  - Intended to show difficulty of problem, security of encryption approach and encourage research
  - Receive money $20K - $200K (and fame)
- **Sun Open Performance Contest (expired)**
  - Part of their “Try-and-Buy” Program to get potential customers to test multi-core system
  - Intended to have real-world evaluations
  - Receive test system (and fame, again)

One out of two is not bad! ☺

- **Sun Open Performance Contest Winner**
  - 60 day evaluation using “A Constructive Approach to Integer Factorization”
  - Available at http://www.grebyn.com/t1000/
  - Compared against Pentium IV & Athlon64 systems
  - Done in Ada
- **Awarded Evaluation System**
  - 8 1.0GHz cores x 4 “strands”, 16 GB memory, 2 x 73GB 10K RPM SAS drives, 4 Gigabit Ethernets
  - List price $14,445

Future Motivation???

- **Netflix Prize (not yet expired or won ☺)**
  - Predict Movie Recommendations
  - Intended to encourage research into improvement of recommendation system
  - Receive $1M (and that fame thing, again)
- Eternity II (not yet expired or won either ☺)
  - 256 piece jigsaw puzzle
  - Intended to make the inventor wealthy
  - Receive $2M (fame, glory, notwithstanding…)

The Machine

- 8 x 1 GHz UltraSparc V9 CPU cores (Niagara 1), 4 way hardware “strands”
- 16 GB memory
- 4 x Gigabit Ethernets
- 2 x 73 GB SAS 10000 RPM disk drives
- Solaris 10 (Linux available)
- 1U Physical size
- ***Draws approximately 142 watts***
- **LOUD!** And heavy

Heart of the New Machine

Back To The Present…

- What to do with a ~$15K 32-way computer?
  - Additional multi-tasking “research”
  - Deploy Java application
  - EBay! ☹

Research Approach

- Create Multi-Tasking Test Applications
- Execute
- Analyze Results

Test Applications

- Simple UNIX Utilities Implemented
  - wc – Word Count
  - sum – Check Sum Calculation
- Possibly More Complicated Applications Considered
  - Astronomy
  - File Compression
  - ???

Results

- wc
  - Elapsed time decreased with increased tasks
  - Not quite linear in relative improvement
  - Limited by file I/O
- sum
  - Elapsed time again decreased
  - More linear, as more CPU, less I/O
  - Tasking overhead seems to have limited total throughput to about 50%

Industry Trends in Performance

- Serial Approach
  - Programming Languages
  - Applications
  - Programmers
- Concurrent Approach
  - Programming Languages (and Libraries)
  - Applications
  - Programmers

Industry Environment

- Hardware Multi-Core Paths
  - Intel, AMD, IBM, Tileria also creating multi-core
- Software (System / Language) Support
  - OpenMP, MPI
  - Parallelizing C, C++, FORTRAN
  - Java?
- Industry expects YEARS to leverage multi-core
- University starting to fund training parallelism
- Ada is ready **TODAY!**

Opportunities

- Embedded Systems
  - Communications gear (routers, firewalls, etc.)
  - Set-top boxes (unlikely due to $$$???)
- High Performance Computing
  - Using Ada's "natural" parallelism rather than other languages "add on" features
  - Physics (including astrophysics), weather, video, data mining
  - Simulations
- Commodity Applications
  - Build once, sell **LOTS**

Challenge

- Ada community too cloistered
  - Many of the same speakers and topics
  - Dwindling numbers
- Limited focus
  - Academic, contractor and tools community
  - Niche market not allowing for growth
  - Few non-Ada focused product companies
- Constrained market view
  - Build onesy, twosey, maybe 26, maybe 200
  - Not build one, deploy thousands, millions, …

Questions & Answers

- Is multicore necessarily slower clock speed?
  - Yes, heat dissipation and power consumption issues
- Why didn't you use GNAT GPL?
  - Obsolete version
  - Restrictive licensing
  - GCCFSS opportunity
- How about comparing Ada to other languages?
  - Offers of funding will be considered... ☺
- How does multicore differ from SMP or network distributed?
  - Essentially interconnect speeds
  - But beware the "8 Fallacies of Distributed Computing"