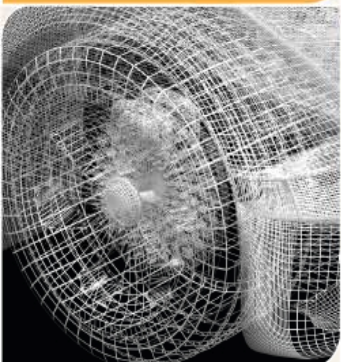


# Unleashing the Power of the Cell Broadband Engine

David A. Bader



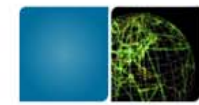
**Georgia  
Tech**



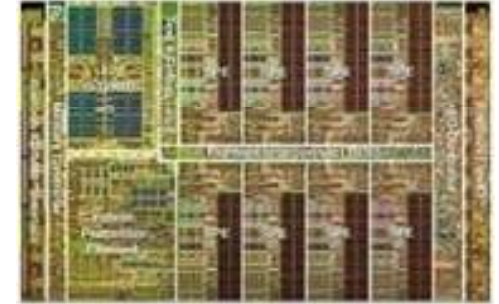
College of  
Computing

Computational Science and Engineering

# Sony-Toshiba-IBM Center of Competence for the Cell Broadband Engine Processor



- ❖ **Mission:** grow the community of Cell Broadband Engine users and developers
- **Fall 2006:** Georgia Tech wins competition for hosting the STI Center
- First publicly-available IBM QS20 Cluster
- 200 attendees at 2007 STI Workshop
- Multicore curriculum and training
- **Demonstrated performance** on
  - Multimedia and gaming
  - Scientific computing
  - Medical applications
  - Financial services



David A. Bader, Director



**TOSHIBA**

**IBM**

<http://sti.cc.gatech.edu>

# Cell Libraries: FFT and JPEG2000

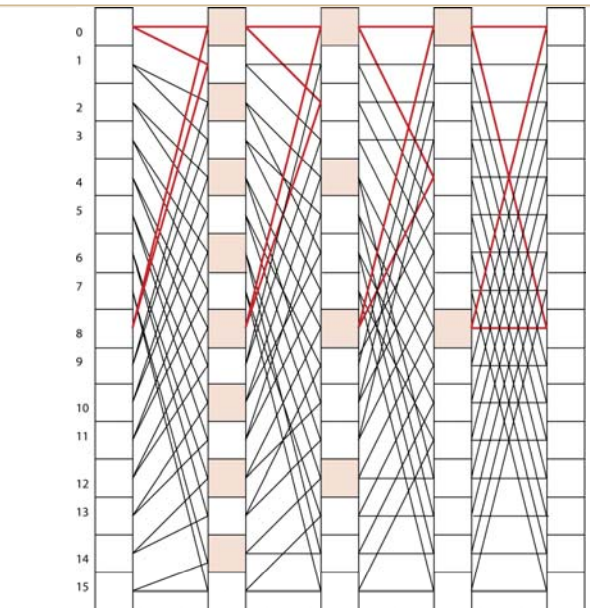
- **FFTC: Fastest Fourier Transform on the Cell/B.E.**

- 1-Dimensional single precision DIF-FFT optimized for 1K-16K complex input samples
- Parallelize & optimize computation of a single FFT computation
- Design high performance synchronization barrier using inter-SPE communication
- Demonstrated **superior performance of 18.6 GFlop/s** for 8K complex input samples.

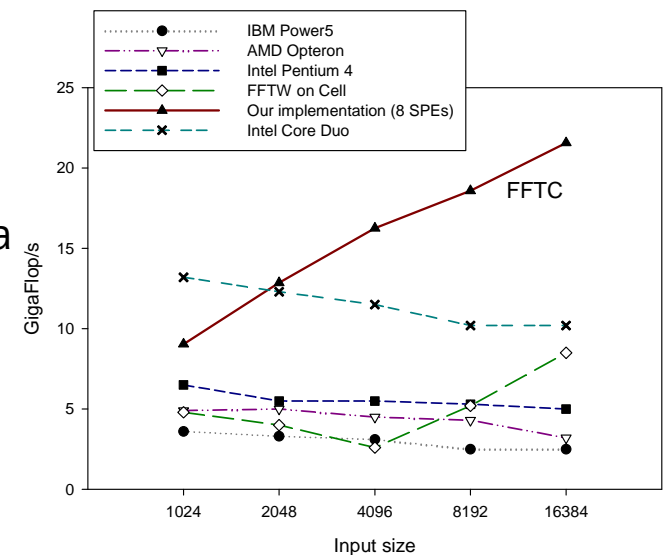
- **JPEG2000 on the Cell/B.E.**

- Optimize coding/decoding by data decomposition / data alignment / vectorization
- Demonstrated average **speedup of 3.1** over Intel 3.2 GHz Pentium-4

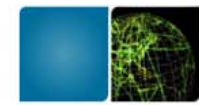
The source code is freely available from our CellBuzz project in SourceForge  
<http://sourceforge.net/projects/cellbuzz/>



*Butterflies of ordered DIF FFT*



# Cell Libraries: ZLIB and MPEG-2

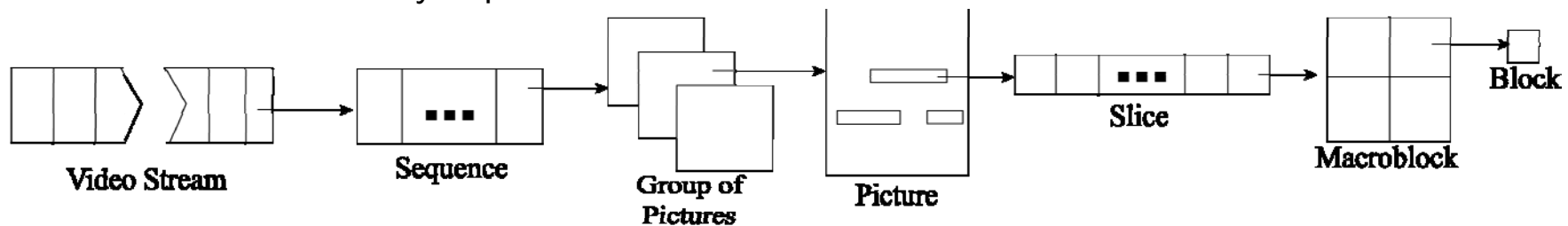


- **ZLIB Data compression & decompression library**

- Vectorize compute intensive kernels and parallelize to run on multiple SPEs
- Extend the *gzip* header format while maintaining compatibility with legacy *gzip* decompressors
- Demonstrated **speedup of 2.9** over high-end Intel Pentium-4 system

- **MPEG-2 Video Decoding**

- First parallelization of a multimedia application on Cell/B.E.
- Demonstrated a **speedup of 2** over Intel 3.2GHz Xeon using 8 SPEs. **Speedup of 10.55** over a PPE-only implementation



- Optimizing **NAS Parallel Benchmarks** on Cell/B.E. using the IBM XL C/C++ multicore acceleration single source compiler (SDK 3.0)

The source code is freely available from our CellBuzz project in SourceForge  
<http://sourceforge.net/projects/cellbuzz/>

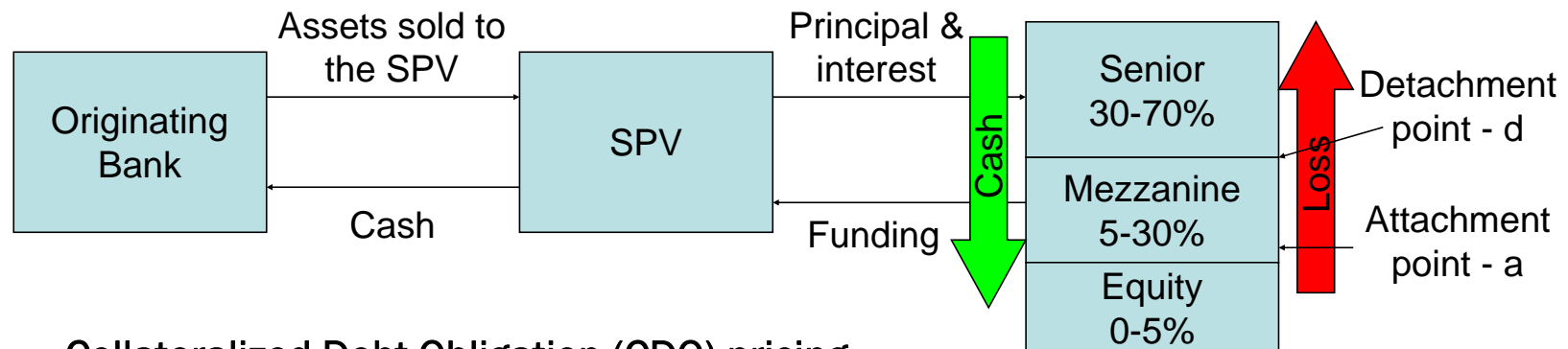


# Cell Applications: Financial Modeling

*Lets Talk about Money!*

## Financial Modeling on the Cell/B.E.

- **Objective:** Demonstrate a competitive edge of the Cell/B.E. for Financial Services.
- **European Option Pricing.** Black - Scholes equation:  $dS(t) = \mu S(t)dt + \sigma S(t)dW(t)$



- Collateralized Debt Obligation (CDO) pricing
- Monte Carlo simulation
- Performance results:
  - **Speedup of 20** of our optimized implementation of Mersenne Twister random number generator on Cell/B.E. over most commodity processors.
  - European Option Pricing:
    - **1.5x over optimized CUDA implementation for NVIDIA G80.**
    - **2x over optimized implementation for RapidMind on Cell.**
    - Double precision is essential.