



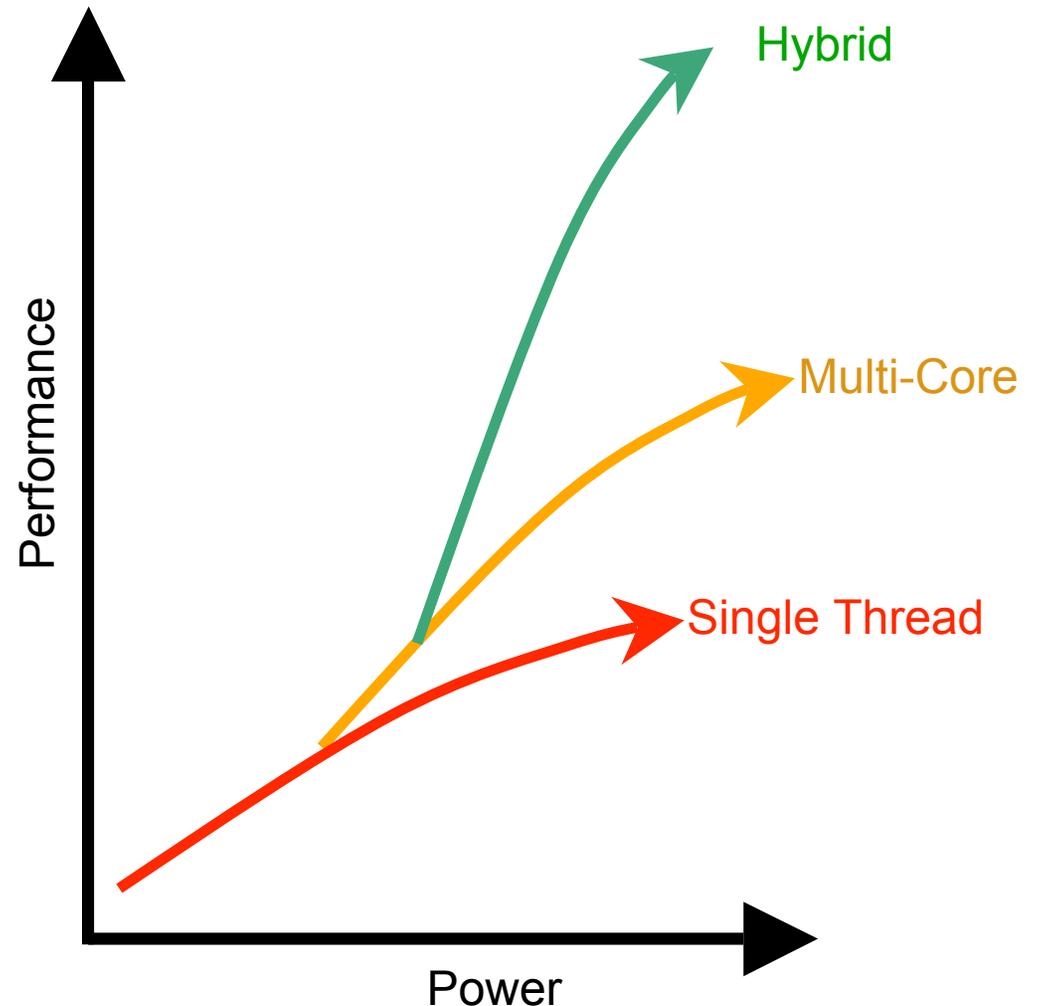
# Programming the Cell Broadband Engine(TM)\*

**H. Peter Hofstee, Ph. D.**  
**Cell BE Chief Scientist and**  
**IBM Systems and Technology Group**  
**SCEI/Sony Toshiba IBM (STI) Design Center**  
**Austin, Texas**

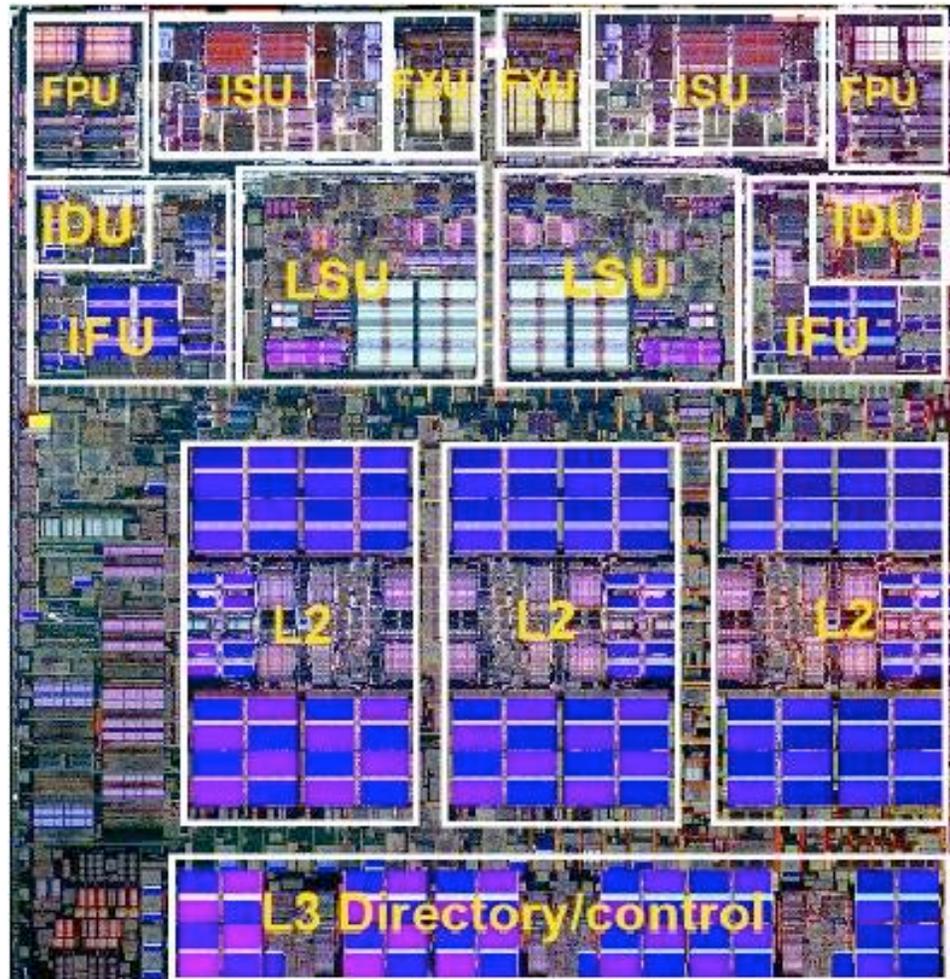
*\*Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc.*

# Microprocessor Trends

- Single Thread performance power limited
- Multi-core throughput performance extended
- Hybrid extends performance and efficiency



## Traditional (very good!) General Purpose Processor



*IBM Power5+*

# Cell Broadband Engine™: A Heterogeneous Multi-core Architecture



\* Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc.

## Intro

Only one key idea ... asynchronous load (DMA)

Software-managed “local store” memory in SPE

Gather-Compute-Scatter thread programming model

But don't change any more than you need to

Power architecture for OS & control

Power Arch governs:

Memory (coherence) model

SPE DMAs are coherent

Address translation/protection

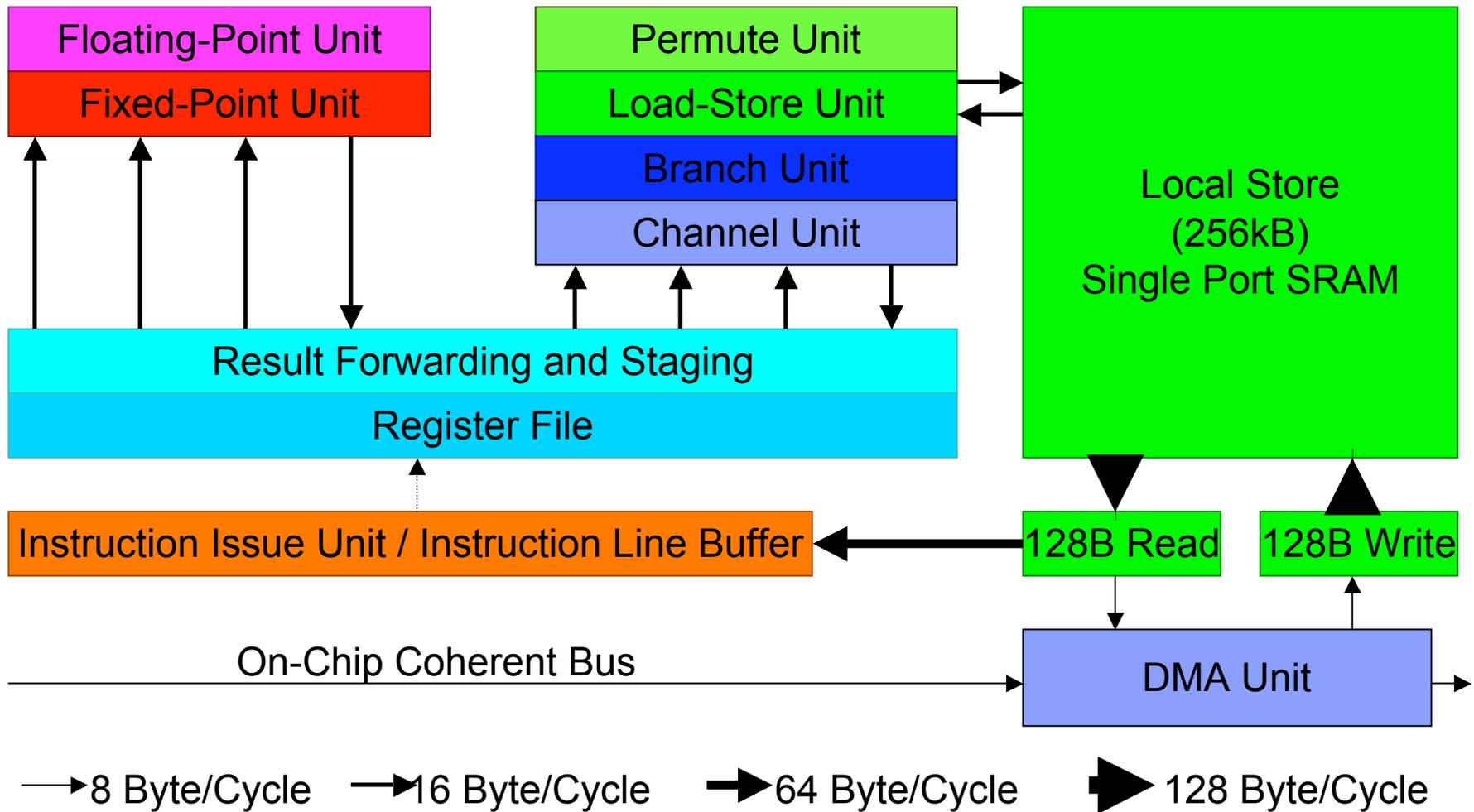
Virtualization ( hypervisor )

Additional constraint:

Optimize for performance/W AND performance/mm2

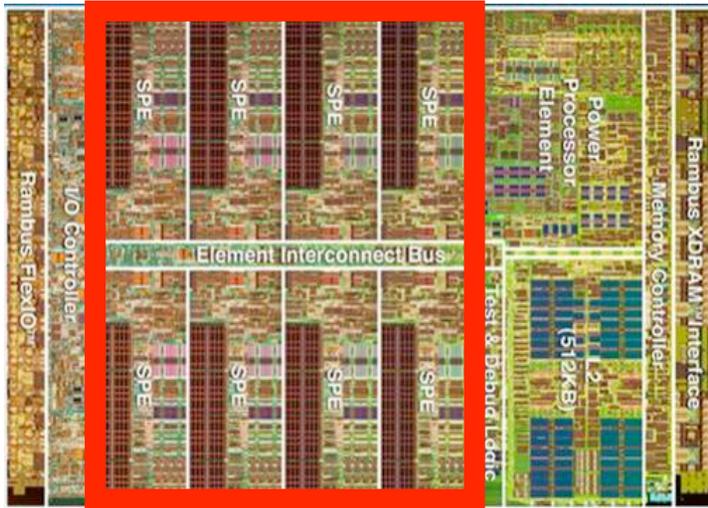
Drives number of microarchitectural decisions in SPE

# SPE BLOCK DIAGRAM

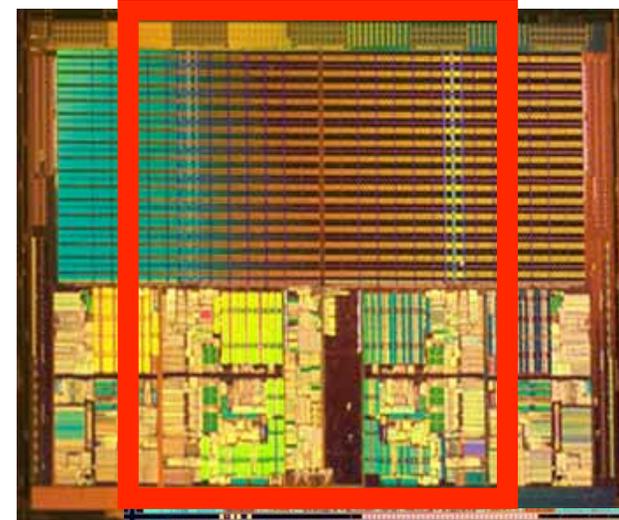


# Memory Managing Processor vs. Traditional General Purpose Processor

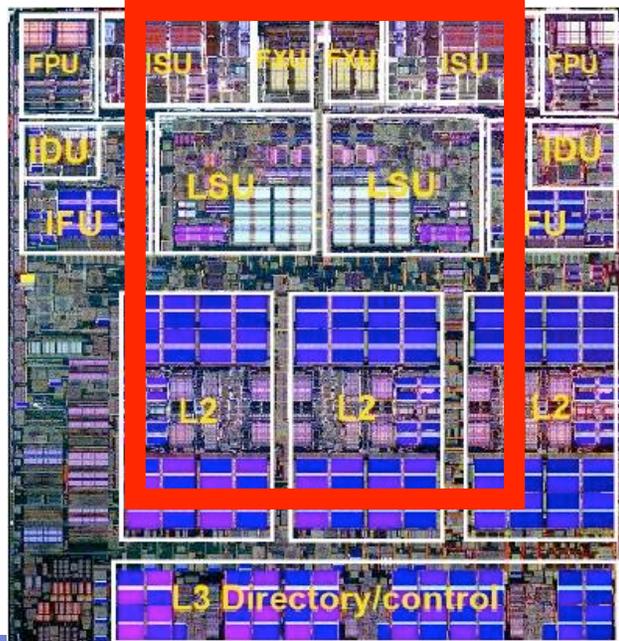
Cell  
BE



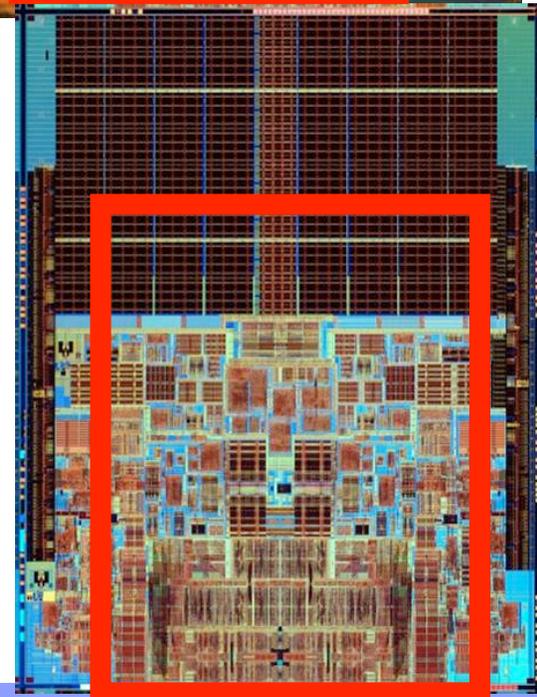
AMD



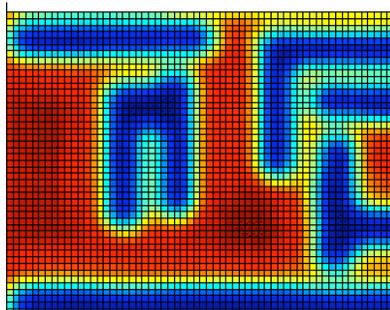
IBM



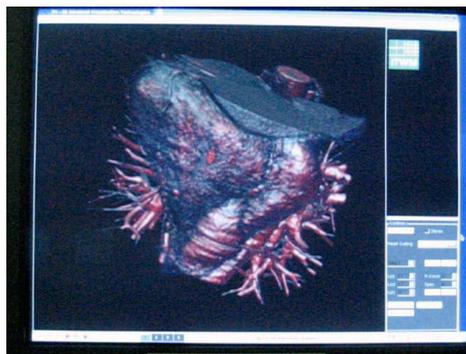
Intel



# Great traction for Cell BE Beyond Gaming



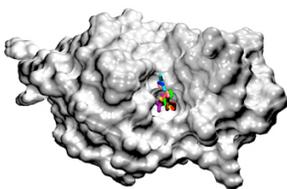
Mercury/Mentor Graphics  
45nm OPC tool



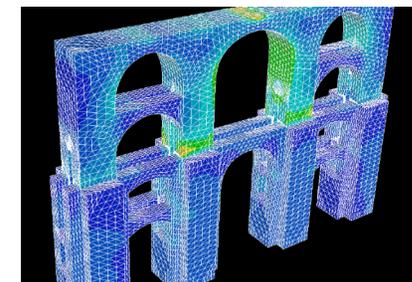
Fraunhofer  
PV4D Medical Imaging



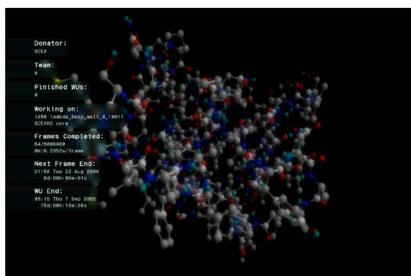
I.B.M. to Build Supercomputer Powered by Video Game Chips  
By JOHN MARKOFF  
(NY Times): September 7, 2006



Boston Univ.  
Bioinformatics: FBDD



Structural Analysis  
digitalmedics.de



SCEI / Pande (Stanford)  
folding@home PS3 client



Rapidmind(TM) / RTT

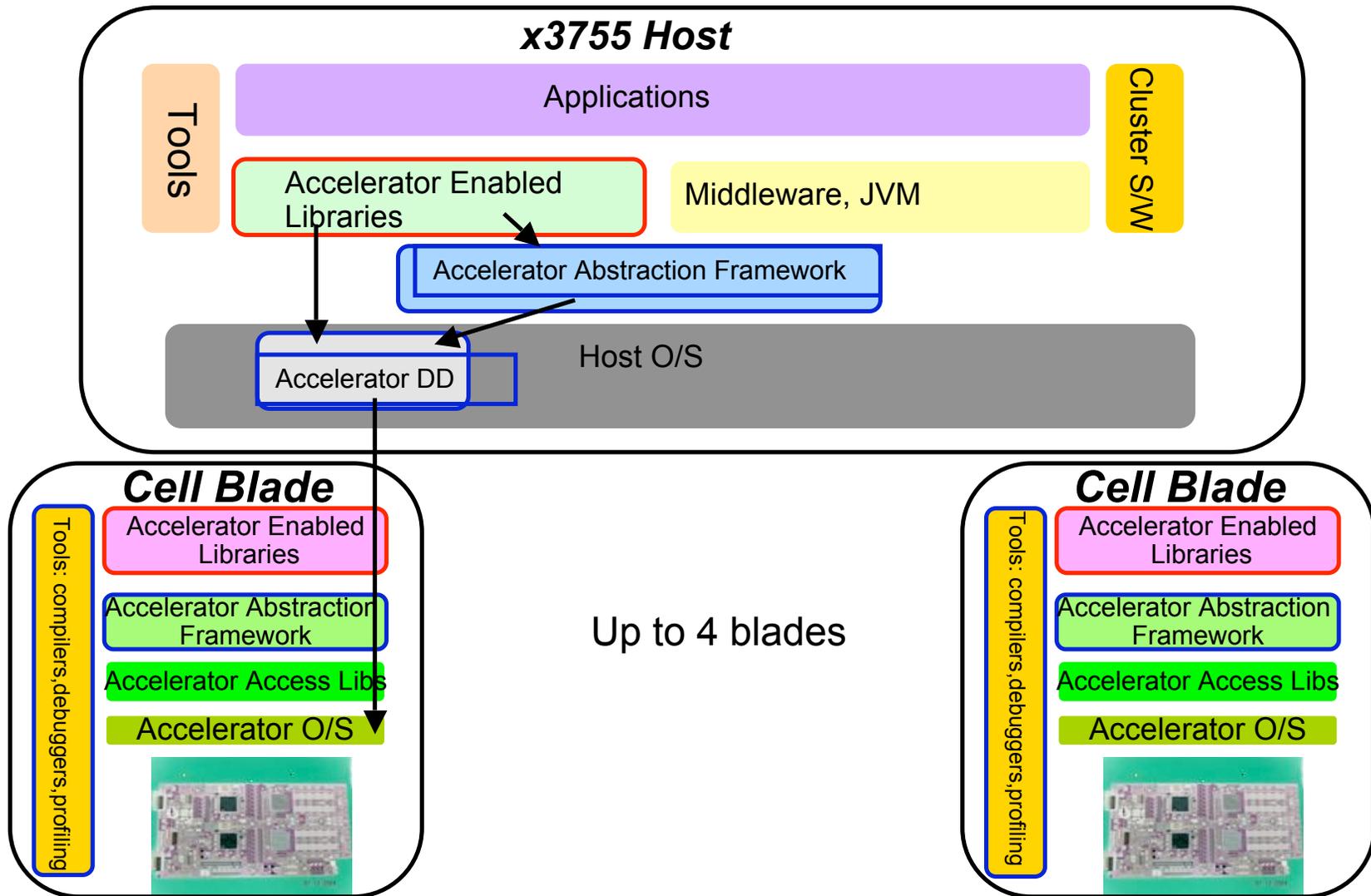


IBM iRT raytracer prototype

## Cell BE Software Enablement

- Today:
  - Base SDK, good compilers for SPE
  - Library/API support for game space (e.g. Ageia)
- Next focus:
  - Library, API development for other spaces (like HPC)
  - Cell as an accelerator
- In early stages, but very promising
  - Single source (per Cell BE) compiler based approaches
    - Task based models (Sequoia, OpenMP w. tasks)
  - RapidMind(TM) development platform
  - Software managed caches
  - Many others ..

# System Software Stack (esp. for Cell as Accelerator)



# Common Linux-based SDK For Cell BE from Game Consoles to Supercomputers



**Cell BE Software Development Kit (SDK) Version 1.1**

**GNU Toolchain**

**IBM XL C/C++ Compiler**

**IBM Full System Simulator**

**Sysroot Image for System Simulator**

