

# Delivering Leadership in C Technology Today and tomorrow –

## for Grids

Sept 22th, 2008  
EGEE 08 Conference  
Istanbul

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# Agenda

Intel HPC and Grid activities

Leading technology today

.... And tomorrow

Enabling Grid and beyond

# Intel in the Grid

Intel is driving HPC technology and Network technology

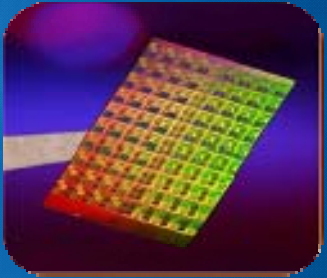
Intel Volume - HPC technology enables Clusters

Clusters and Networks enable Grids

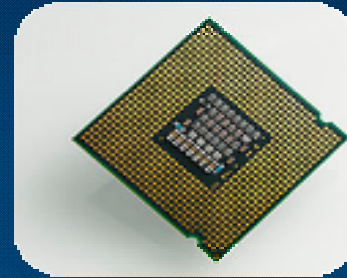
Intel has direct involvement in the Grid area



# Intel in High Performance Computing



Teraflops  
research



Leading  
performance,  
performance/watt

Dedicated,  
renowned  
expertise



Large scale  
clusters  
for test and  
optimization



Broad S  
tools  
portfolio



Defined  
HPC  
application  
platform



Platform building  
blocks

A Long Term Commitment to HPC Solutions

# Intel's Grid Activities

to prototype Grid components

to simplify creation of portable Grid applications

to create a Programming Environment (GPE)

to use Beans encapsulate application user interfaces

to enable management and use of virtualized resources (CERN cooperation)

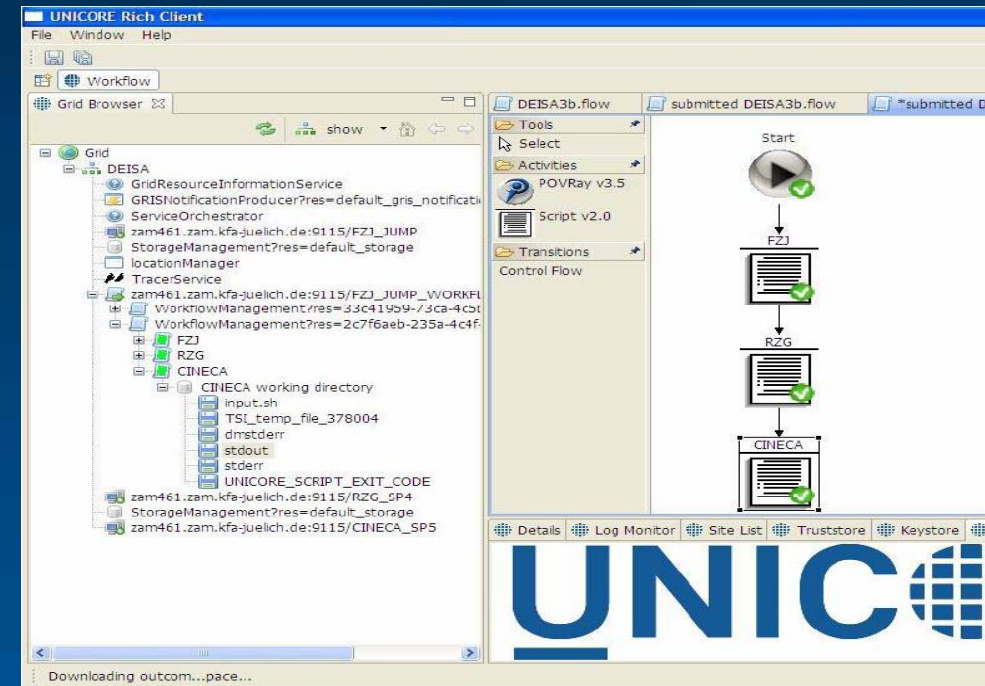
to encourage development by the Unicore family of projects (FZ Juelich)

to work with Grid experts and users

to participate in European-union funded R&D projects (UniGrids, GRID, SimDAT)

to work with ecosystem, standards bodies

to participate in Grid Forum (technical influence, board membership)



Graphical User Interfaces

GridBean SDK

Higher-level Services

Atomic Services

Execution Agents

Execution Agents

Data Center

# Scaling technology forward

*New Materials and Design*

*Single Core Enhancements*

*Multi to Many-Core*

*Platform Enhancements*

Intel  
Architecture  
Core





# Scaling technology forward

*Tri-Gate, Nanotubes →*

*MMX → SSE → AVX →*

*Dual → Quad → ...*

*PCIe, IMC, QPI, SOC →*

Intel  
Architecture  
Core



# Tick/Tock: Our Model for Sustained Microprocessor Leadership



Intel®  
Core™  
NEW  
Architecture  
nm  
06

**Penryn**  
Compaction/  
Derivative  
**45nm**  
2007

**Nehalem**  
NEW  
Microarchitecture  
45nm  
2008

**Westmere**  
Compaction/  
Derivative  
**32nm**

**Sandy  
Bridge**  
NEW  
Microarc  
32

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*Forecast*

# Scaling Performance Forward

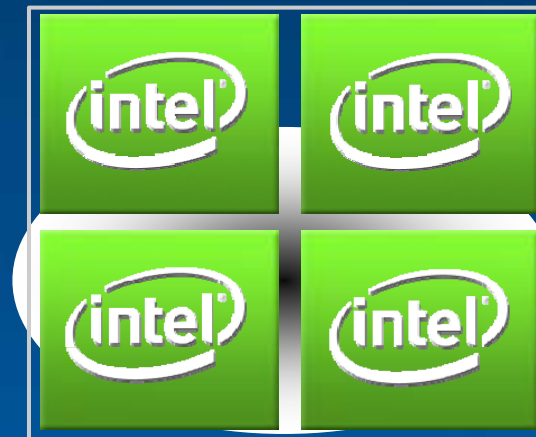
Scaling Moore's Law Through  
a Viable Future

Additional software

(C++) Intel software tools :  
generate, generating optimized,  
code

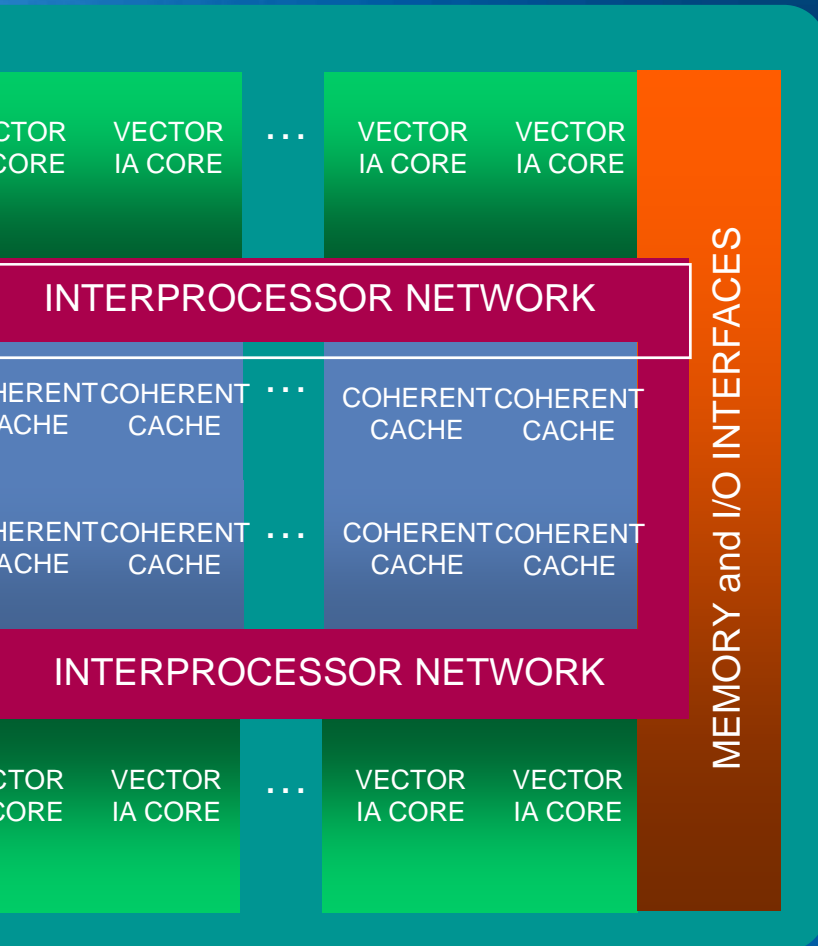
and Computing:

Processor Capacity, Memory Capacity,  
Bandwidth Capacity



Scaling Performance Forward To Multi & Many Core Solutions

# Throughput Computing: A Many Processor Architecture. LARRABEE



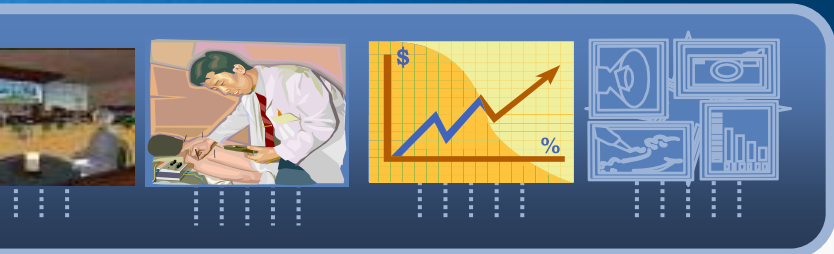
**Larrabee is Intel's first many core processor**

**First Larrabee product targets entertainment graphics**

**Each core is a complete Intel processor**

**Efficient inter-block communication**

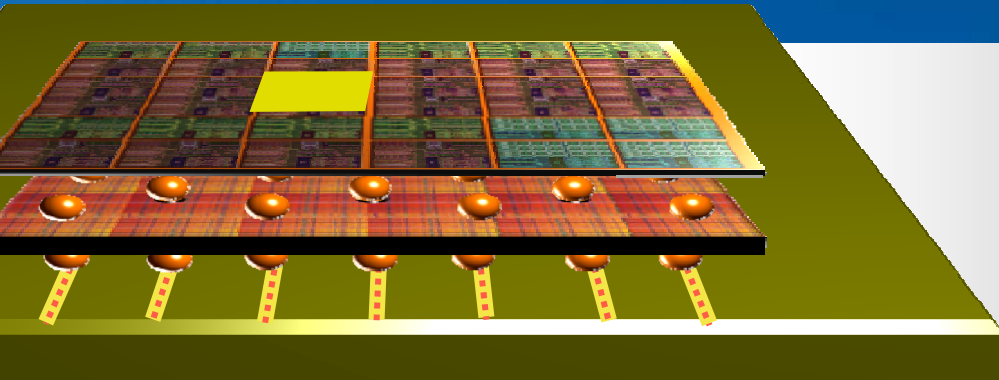
# The Challenge Parallel Programming



Irregular Patterns, Data Structures and Algorithms



Scale to Multi-Core Today → Hard  
Scale to Many-Core Tomorrow → Harder

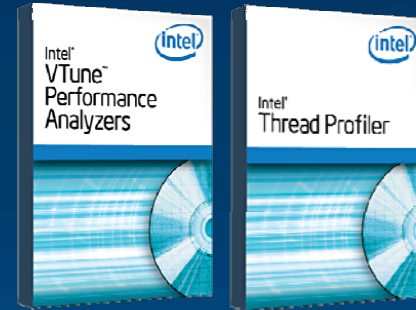


Increasing Cores  
Vector Instructions  
Cache and Interconnect Latency



# Today: Intel® Software Tools for Parallelism

Architectural Analysis



Introduce Parallelism



Confidence / Correctness



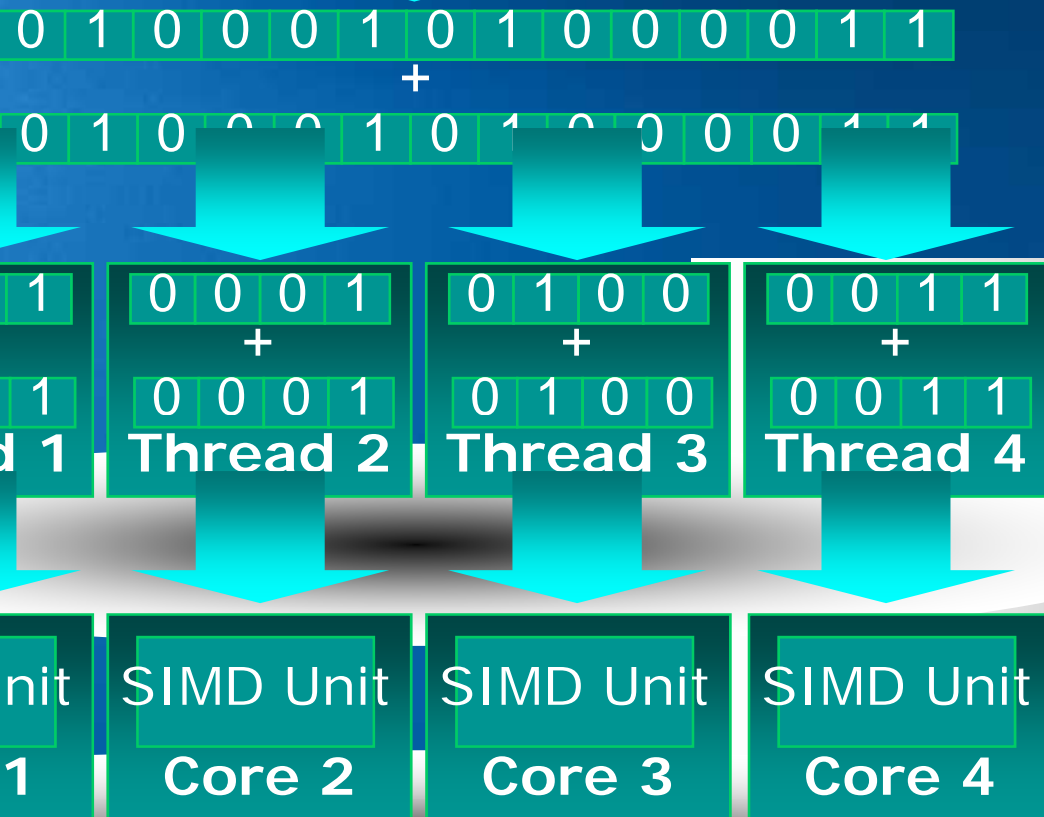
Optimize / Tune



# Research: Ct: A Throughput Programming Language

```
TVEC<F32> a(src1), b(src2);  
TVEC<F32> c = a + b;  
c.copyOt(dest);
```

User Writes Serial-Like  
Core Independent C++ Code



Primary Data Abstraction is the Nested  
Supports Dense, Sparse, and Irregular

Ct Parallel Runtime:  
Auto-Scale to Increasing Cores

Ct JIT Compiler:  
Auto-vectorization, SSE,  
AVX, Larrabee

**Programmer Thinks Serially; Ct Exploits Parallelism**

# practical case: CERN – Chasing The Intractable



res into the subatomic world – latest experiment: LHC

Analysis Grid for LHC – Revolutionizes the way scientists

analyze data

lab collaboration essential for building the IT infrastructure

tributes in a unique technology collaboration since 2003

ience At The Edge Meets Technology At The Edge

# Beyond: Cloud computing

Yahoo create cloud-computing labs

08 17:22

Cloud infrastructure for researchers will help advance the technology, according to the companies. Microsoft and Yahoo, in conjunction with academic and other institutions around the world, have announced the creation of a global, experimental test bed for cloud computing. The Cloud Computing Test Bed will consist of six 'Centers of Excellence', with the University of Illinois at Urbana-Champaign (UIUC), the Karlsruhe Institute of Technology in Germany and the Infocomm Development Authority of Singapore joining in with the three companies.

## The next step

- Grid “grown up” in academic / research community (also because of EGE)
- In the commercial areas “Cloud Computing” is one of the big areas of development
- Intel is again engaged in this Area

# Summary

Master of COTS HW important for Grids

More's Law Continues To Double Transistors Every  
Months

More Core's, More Cache, More Memory, More  
Bandwidth Delivers Performance

Real Software Tools Enable You To scale Performance  
Forward

Intel's leading technology enables Grids and we are  
actively contributing



# Have a successful conference

Putting it all together

**HPC @ Intel**