

National Research Initiative Proposal (DFG-Schwerpunktantrag)

Manycore: Many Cores for the Masses

SEPARS-Meeting, Saarbrücken, 06.11.2009

Christian Lengauer

DFG – National Research Initiatives

- *Idea:* coordinated support of research on emerging topics that promote German science and economy
- *Volume:* upto 30 projects plus coordination (€10-12M)
- *Duration:* six years (review every two years)
- *Number:* around 16 new initiatives per year
- *Currently active initiatives:* 96
- *Proposal deadline:* 15. November
- *Decision date:* end of April
- *Quotas:* none

Manycore Initiators

Arndt Bode (Technische Universität München)

Andreas Herkersdorf (Technische Universität München)

Wolfgang Karl (Universität Karlsruhe (TH))

Christian Lengauer (Universität Passau) – Koordinator

Michael Philippsen (Universität Erlangen-Nürnberg)

Thomas Rauber (Universität Bayreuth)

Gudula Rünger (Technische Universität Chemnitz)

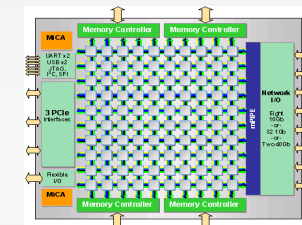
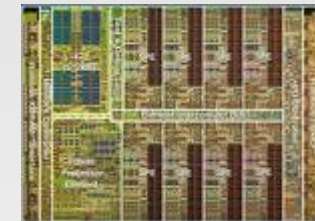
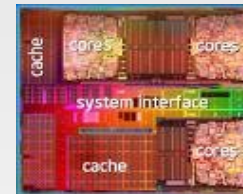
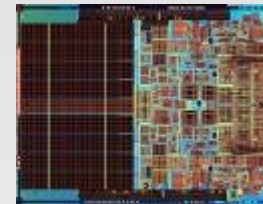
Walter Tichy (Universität Karlsruhe (TH))

Theo Ungerer (Universität Augsburg)

Manycore Thesis

The manycore will be the prevalent platform in the near future.

- 1999: Sun MAJC (2)
- 2001: IBM Power4 (2)
- 2005: Intel Core Duo (2)
- 2006: IBM Cell B.E. (1+8)
- 2008: Intel Dunnington (6)
- 2008: Sun Niagara 2 (8)
- 2010: Intel Larrabee (32)
- 2011: Tiler TILE-Gx (≤ 100)



Develop software technology for manycore platforms that are general-purpose and available in large quantities

- Requires a fundamental paradigm shift of software technology
- Manycore parallelism \neq classical high-performance parallelism: more shared memory, less static, less homogeneous, less structured
- Manycore parallelism can have other benefits than speed: power reduction, reliability, security, flexibility, convenience
- Classically separate research areas have to be brought together: algorithms, programming languages and tools, run-time and operating systems, applications, (architecture)

- Advancing the state of the art of parallel programming

abstraction

virtualization

optimization

software architectures, patterns, skeletons

domain-specific languages

- What if the application is "too sequential"?

Lend additional support with:

analyses and searches

display and provision of additional data

hints, warnings, guidance

just-in-time optimizations and repair

- **Graph Data Mining and Powerful Pattern Matching**
 - Search for molecule fragments in pharmaceutical databases
 - Search for common subexpressions in a syntax tree
 - Pattern recognition on long-term electrocardiogram devices
- **Visualization of Data**
 - Visualization of the state of a network to discover anomalies and misuse
 - Visualization of finance information in order to correlate data
- **Realistic 3D-Graphics**
 - Interactive computer games
 - Animation in movies
 - Image-producing medicine
- **Applications in the Finance Sector**
 - Value-at-risk computations
 - Algorithmic trading

- **Applications in Scientific Computing**
Simulation (every core handles one aspect)
Transition from expensive special-purpose installations to cheap mass installations
- **Embedded Systems in the Automotive Sector**
Transition from >80 dedicated processors to a few manycores
Image analysis and processing in driver assistance systems
- **Programming**
Additional illustration, analysis and decision support
Fragmentation of monolithic compilers and operating systems
and distribution of the fragments across separate cores
- **Program Optimization**
Dynamic load balancing
Much more "just in time"
Autotuning

Interest and Support

- Researcher poll
79 proposal announcements by 64 researchers
- Industrial support:
so far 20 supporting letters



FAK: INFORMATIONSSYSTEME AG



Audi



"This research challenge represents the most significant of all IT challenges over the past 50 years."

"If researchers meet the parallel challenge, the future of IT is rosy. If they don't, it's not."

[Communications of the ACM, October 2009]