



Next Generation Computing Systems

パネル討論:新時代におけるマルチコア戦略

Multicore: an IBM's Perspective

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Key Industry Trends

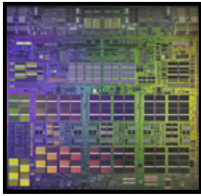
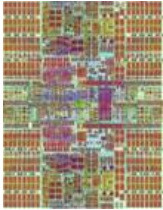
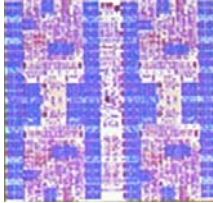
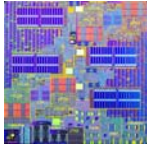
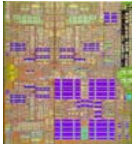
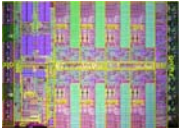
- **More transistors and slower clocks mean multicore designs and more parallelism required**
- **Thicker “memory wall” means that communication efficiency will be even more essential**
- **Limitations of commodity processors will further increase heterogeneity and system complexity**

Source:

Jack Dongarra, et al, “The Impact of Multicore on Computational Science Software”

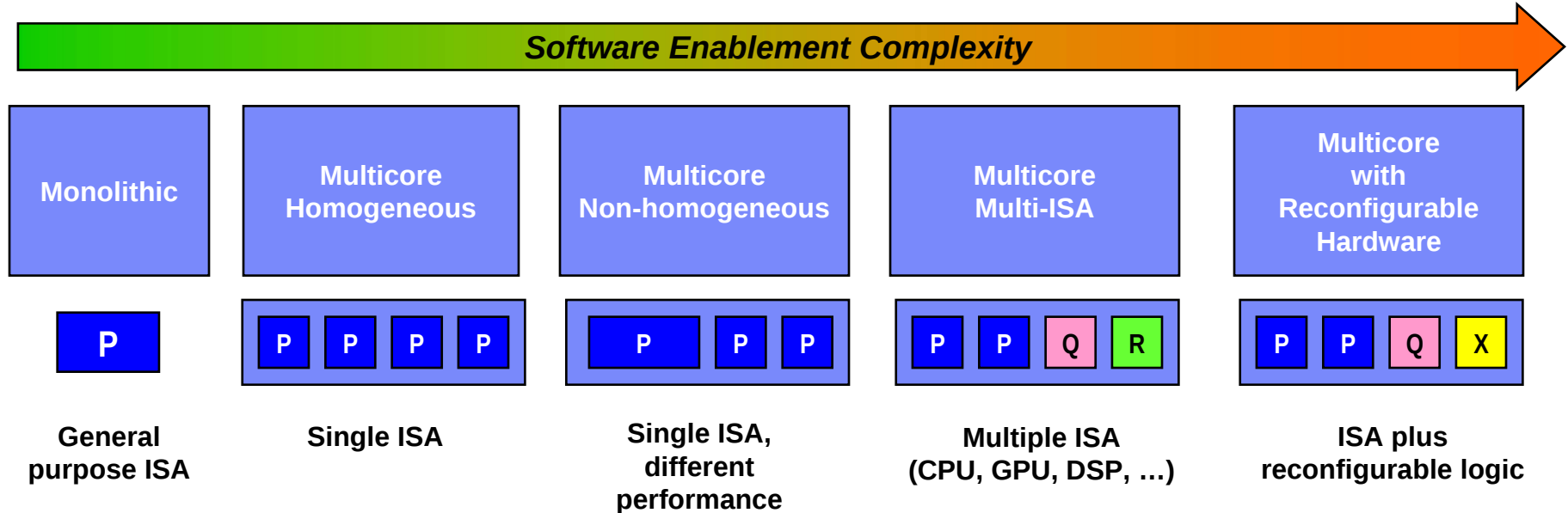
<http://www.ctwatch.org/quarterly/articles/2007/02/the-impact-of-multicore-on-computational-science-software/1/>

Example of IBM's Multicore Processors

	POWER5	POWER6	Z10 EC PU	BlueGene/P	Xbox360 CPU	Cell/B.E.
Technology	130nm	65nm	65nm	90nm	90nm	90nm (1 st Gen)
Die Size (mm ²)	389	341	465	169	165	235
Transistor (M)	250	790	994	208	168	241
ISA Type	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Heterogeneous
Cores/Chip	2	2	4	4	3	9 (1PPE+8SPE)
Threads/Core	2	2	1	1	2	PPE:2 / SPE:1
L1 Cache (KB)	I:64, D:32	I:64, D:64 /core	I:64, D:128 L1.5: 3,072 /PU	I:32, D:32 /core	I:32, D:32 /core	PPE:I/D: 32 SPE: LS 256
L2 Cache (MB)	1.9 (Shared)	8 (4/Core)	48 / Book	0.002 / Chip	1 (Shared)	PPE: 0.5
L3 Cache (MB)	32 (External)	32 (External)	~352G /Book	8 (Shared)	--	--
Clock (GHz)	1.9 - 2.3	>5.0	4.4	0.85	3.2	>3.2
						
Target System	General Purpose Servers			Workload Optimized Systems		

Momentum for Heterogeneity

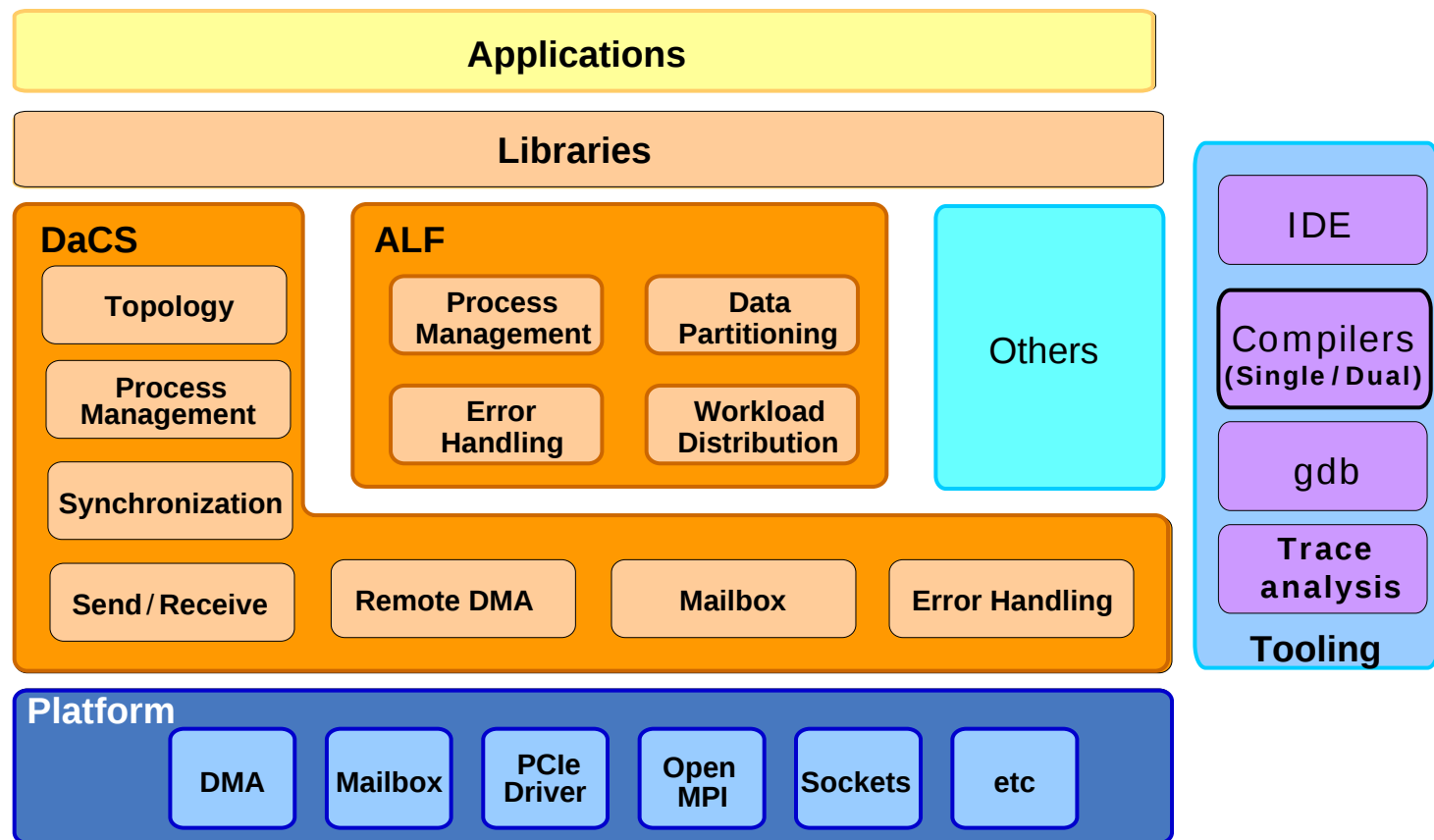
- Mixed compute power, ISA, etc.
- Specialization (accelerators), driven by performance & efficiency
 - e.g., Cell-blades, Roadrunner, GameFrame, lots more...



- **SW challenge:**
 - *Integrated programming model (not just accelerate through I/O)*

IBM SDK for Multicore Acceleration: Software Enablement for Multicore Memory-Hierarchy Systems

- Allow programming without awareness of ISA, architecture differences
- Support hybrid programming model (PPE-SPE, X86-Cell/B.E.)



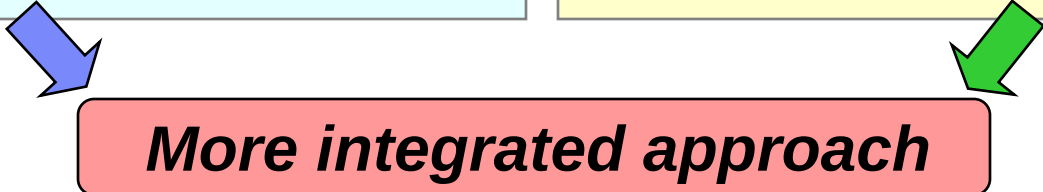
Typical Multicore Exploitation Techniques

Existing Applications

- Automatic and efficient exploitation of parallelism through compiler, operating system and hardware support
- Technology to boost utilization through consolidation
- Leverage middleware and OS containers
- New tools, reusable software components, pre-tuned for multicore, incremental use of patterns

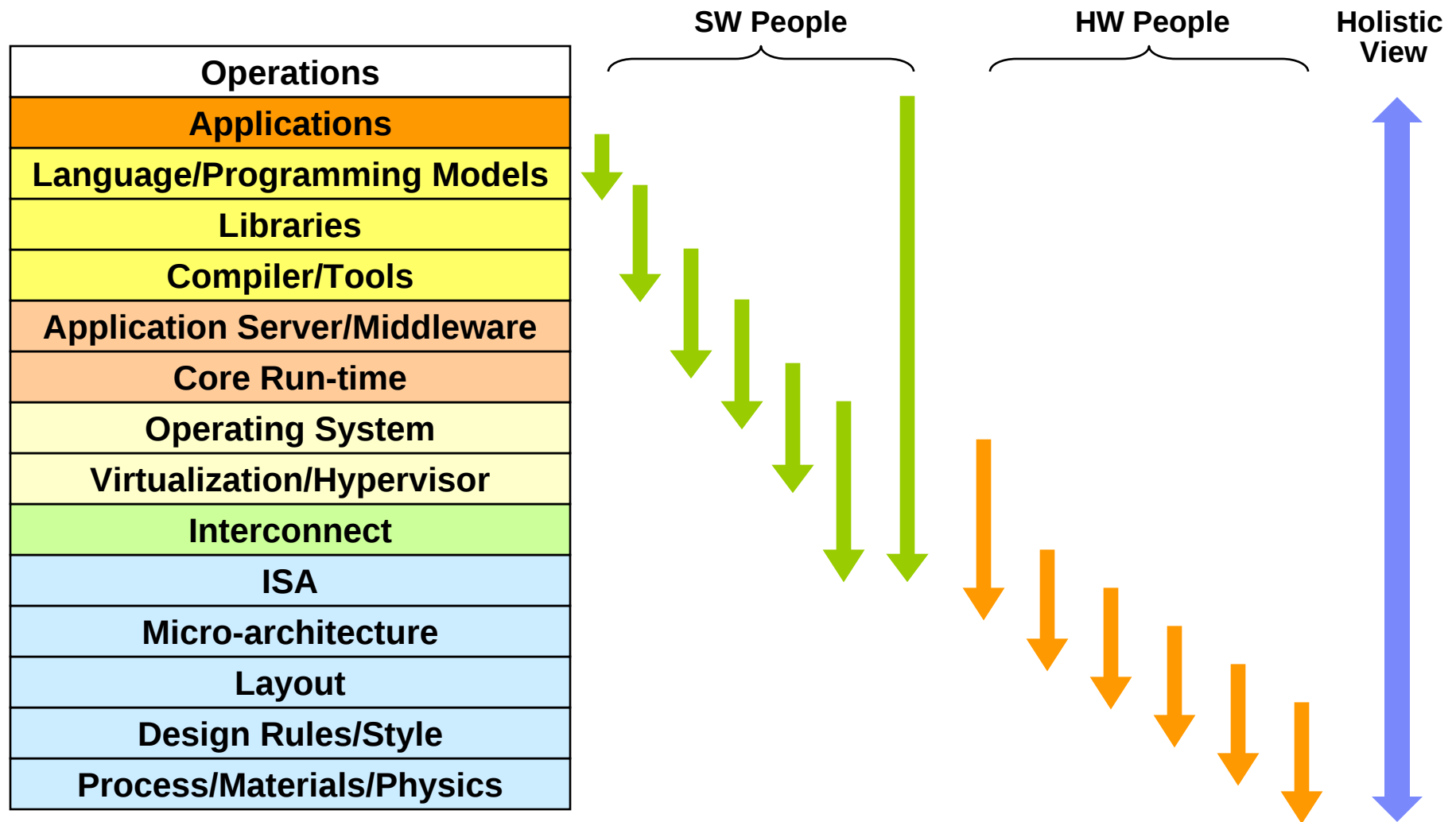
New (Emerging) Applications

- The “accelerator” pattern
 - Fundamental programming models and languages designs to support heterogeneous, asynchronous processor complexes
- The streaming pattern
 - Programming models for streaming applications
 - Optimized runtimes for processing of massive data streams
- New programming models:
 - Multicore concurrency at a Java level (e.g. X10)
 - New models built to assume massive concurrency



More integrated approach

Holistic Approach Becomes More Crucial



Example: IBM BlueGene has its own stack with large performance boost from working across layers.

Expectations to Academia (in Japan)

- **Measurement / Evaluation methodology for Multicore Era**
 - Benchmarking for emerging workloads
 - Still LINPACK in Top500?
- **Application ideas**
- **Global Presence and Leadership**
 - Global collaboration:
 - e.g., Sony-Toshiba-IBM collaboration created Cell/B.E. innovation.
 - Different ideas and Multi-disciplinary stimulations

Thank You!

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