

Concurrent Systems

Nebenläufige Systeme

XIV. Pickings

Wolfgang Schröder-Preikschat

February 7, 2017



Agenda

Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education

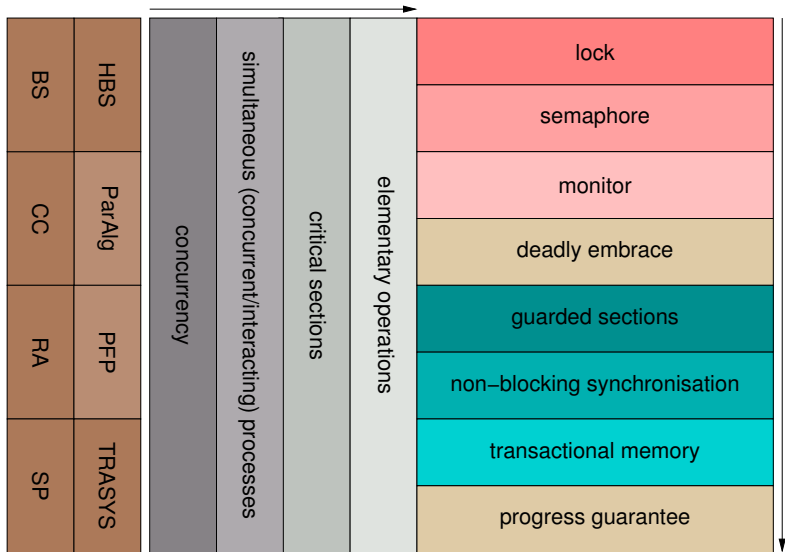


Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education



Content of Teaching and Cross-References



Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education



- **composability** and **configurability**
 - application-oriented (varying, type-safe) system software
- **specialisation**
 - dedicated operating systems: integrated, adaptive, parallel



- **composability and configurability**
 - application-oriented (varying, type-safe) system software
- **specialisation**
 - dedicated operating systems: integrated, adaptive, parallel
- **reliability**
 - gentle fault and intrusion tolerance
- **thriftiness**
 - resource-aware operation of computing systems
- **timeliness**
 - migration paths between time- and event-triggered real-time systems



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 - coordination of cooperation and competition between processes



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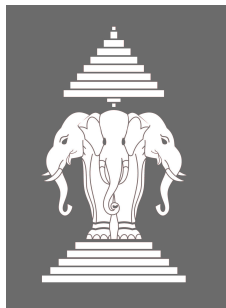
- **concurrency**

- coordination of cooperation and competition between processes

→ “concurrent systems” is more or less **cross-cutting** thereto. . .



Latency Awareness in Operating Systems



¹<http://univis.uni-erlangen.de> → Research projects → LAOS

■ latency prevention

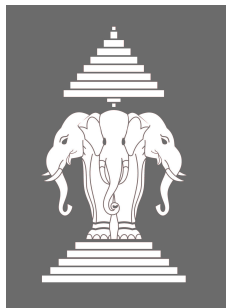
- lock- and wait-free synchronisation
- integrated generator-based approach

■ latency avoidance

- interference protection
- race-conflict containment

■ latency hiding

- operating-system server cores
- asynchronous remote system operation



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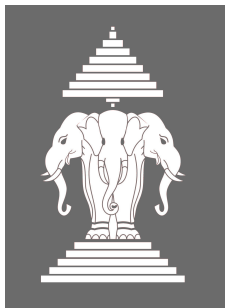
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■ experiments with different **operating-system architectures**

- process-/event-based and hardware-centric operating-system kernels
- LAKE, Sloth



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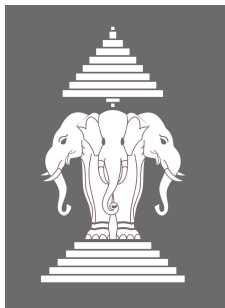
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■ DFG: 2 doctoral researchers, 2 student assistants



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²<http://univis.uni-erlangen.de> → Research projects → COKE

- **event-based minimal kernel**
 - cache-aware main-memory footprint
 - hyper-threading of latent actions



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 - overall kernel-level synchronisation
 - familie of consistency kernels



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- **problem-oriented consistency**
 - sequential, entry, release consistency
 - functional hierarchy of consistency domains
 - memory domains for NUMA architectures



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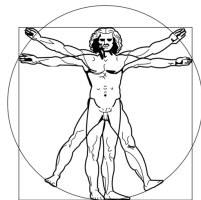
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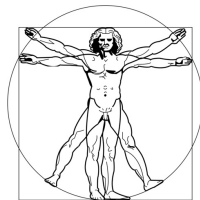
Heterogeneous Resource-Aware Multi-Processing



³<http://univis.uni-erlangen.de> → Research projects → RAMP

■ GPU-centric **resource management**

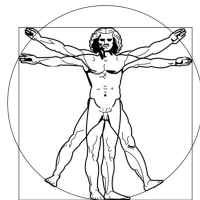
- timely predictable run-time system
 - run-to-completion kernel
- prioritisation and isolation of GPU tasks
 - scheduling according to execution costs
- trade-off handling as to throughput and response time



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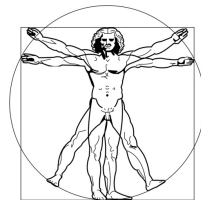
■ RAM-centric **run-time executive** for heterogeneous processors

- application-specific and problem-orientied memory management
- run-time adaptation and relocation of dynamic data structures

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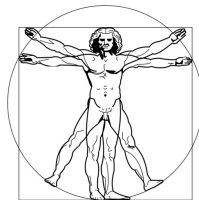
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- support of an incremental improvement of visual quality
- patterns for adaptive detail adaptation of geometry or textures

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Run-Time Support System for Invasive Computing



⁴<http://univis.uni-erlangen.de> → Research projects → iRTSS

Octo

- borrowed from the designation of a creature that:
 - i is highly parallel in its actions and
 - ii excellently can adapt oneself to its environment
- the kraken (species *Octopoda*)
 - can operate in parallel by virtue of its eight tentacle
 - is able to do customisation through camouflage and deimatic displays and
 - comes with a highly developed nervous system
 - in order to attune to dynamic ambient conditions and effects



POS

- abbrev. for *parallel operating system*
 - an operating system that not only supports parallel processes
 - but that also functions **inherently parallel** thereby

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PAX

⁵<http://univis.uni-erlangen.de> → Research projects → PAX

Power-Aware Critical Sections

- scalable synchronisation on the basis of **agile critical sections**
 - **infrastructure** ■ load-dependent and self-organised change of protection against race conditions
 - **linguistic support** ■ preparation, characterisation, and capturing of declared critical sections

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 - mutual exclusion, guarded sections, transactions
 - dynamic dispatch of synchronisation protocols or critical sections, resp.



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 - instruction survey and statistics based on real and virtual machines
 - energy-consumption prediction or estimation, resp.



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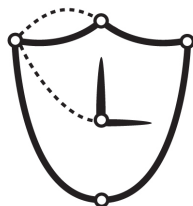
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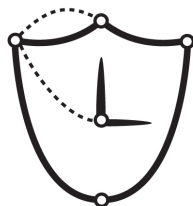
Latency- and Resilience-Aware Networking



⁶<http://univis.uni-erlangen.de> → Research projects → LARN

■ **real-time capable network communication**

- transport channel for cyber-physical systems
- predictable transmission latency
- in a certain extent guaranteed quality criteria



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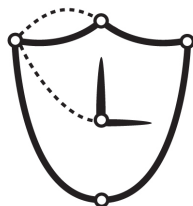
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■ deterministic run-time support

*Auffassung von der kausalen [Vor]bestimmtheit
allen Geschehens bzw. Handelns (Duden)*

- latency-aware communication endpoints, optimised protocol stack
- specialised resource management, predictable run-time behavior



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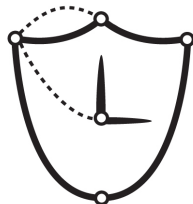
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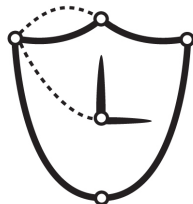
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Multi/Many-Core Processor Pool

fau4*	clock	cores per domain		domain		
		physical	logical	NUMA	tile	
8e 8f	2.9 GHz	8	16	2	—	Xeon
9big01	2.5 GHz	6	—	8	—	Opteron
9big02	2.2 GHz	10	20	4	—	Xeon
9phi01	1.2 GHz	6	12	2	—	Xeon
	1.1 GHz	57	228	2	—	Xeon Phi
scc	1.5 GHz	4	2	1	—	Xeon
	800 MHz	2	—	—	24	Pentium
InvasIC	3.5 GHz	8	16	2	—	Xeon
	25 MHz	4	—	6		LEON/SPARC



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- budgeted acquisition: further n -core systems, transactional memory

OctoPOS ■ $n \geq 64$, in 2015

PAX ■ $n \geq 16$, in 2016, plus several multi-core micro-controllers



Bachelor, Master, or Doctoral Thesis

