Automotive SW/HW Stack

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SITUATION

1985

Lothar Späth buys a Cray 2 ...

... and creates 15 new positions for SME consultants

1995

Foundation of hww and HLRS

hww

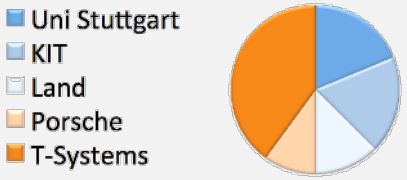
H L R S

Supercomputer-Joint-Venture gegründet

xs. **Stuttgart** (Eigener Bericht) – Eine Betriebsgesellschaft für Hochleistungsrechner hat die *Dr.-Ing. h.c. F. Porsche AG, Stuttgart*, zusammen mit der *debis Systemhaus GmbH, Stuttgart*, einer Tochtergesellschaft der *Daimler-Benz Inter-Services (debis) AG, Berlin*, sowie dem *Land Baden-Württemberg* und der *Universität Stuttgart* gegründet. Die vier Partner haben einen entsprechenden Vertrag im Stuttgarter Finanzministerium unterzeichnet.

ihm nach Meinung des baden-württembergischen Finanzministers Gerhard Maier-Vorfelder die Zusammenarbeit zwischen Land und Industrie gefördert.

Für Porsche bringt die neue Betriebsgesellschaft erhebliche Vorteile für die technische Entwicklung, erklärte Walter Gnauert, im Vorstand für Finanzen zuständig. Durch die Nutzung der Hochleistungsrechner könne Porsche seine Entwicklungsaufgaben effektiver lösen. Dadurch wiederum ließen sich die Entwick-



2011

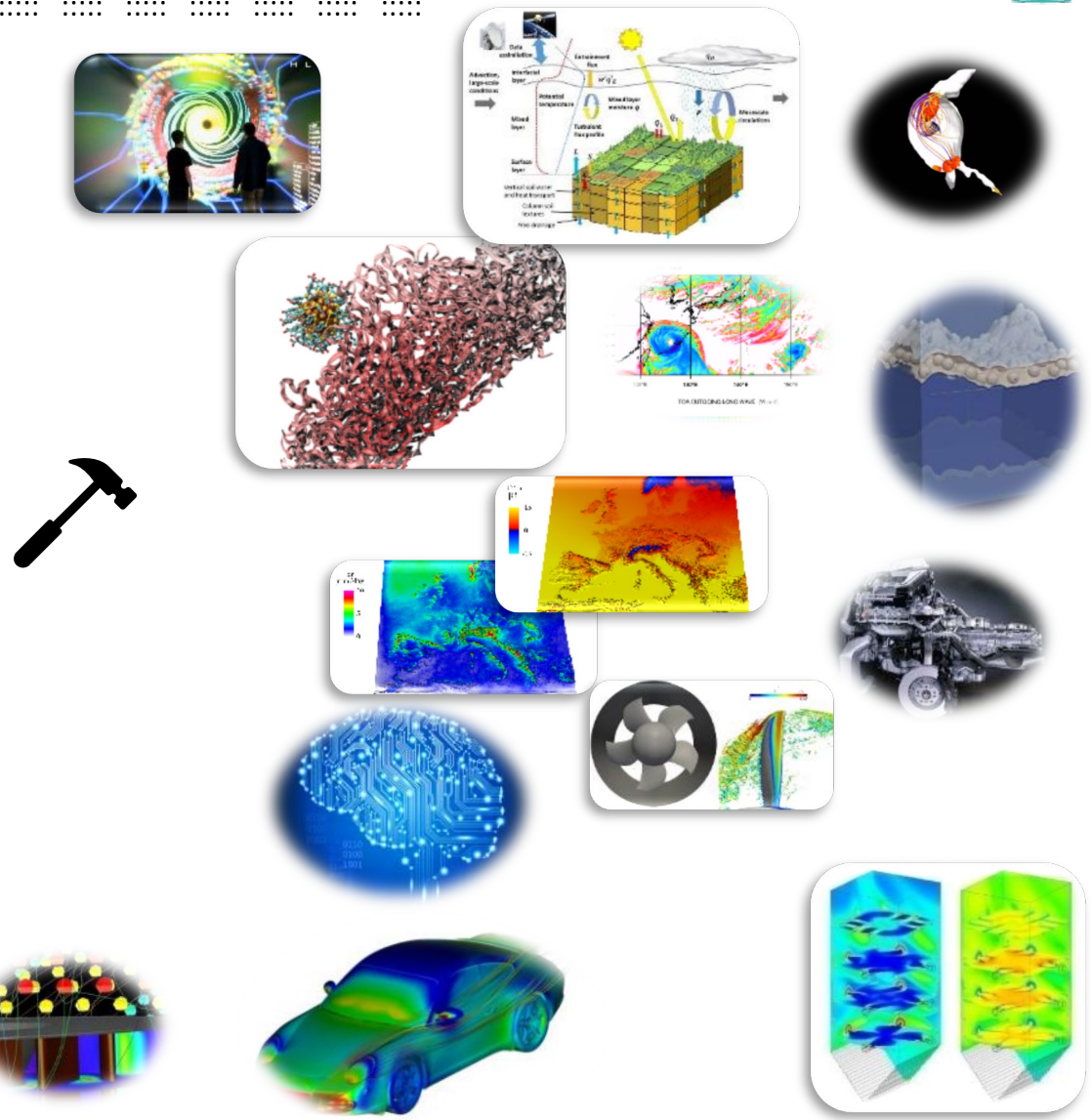
Foundation of SICOS BW

SICOS

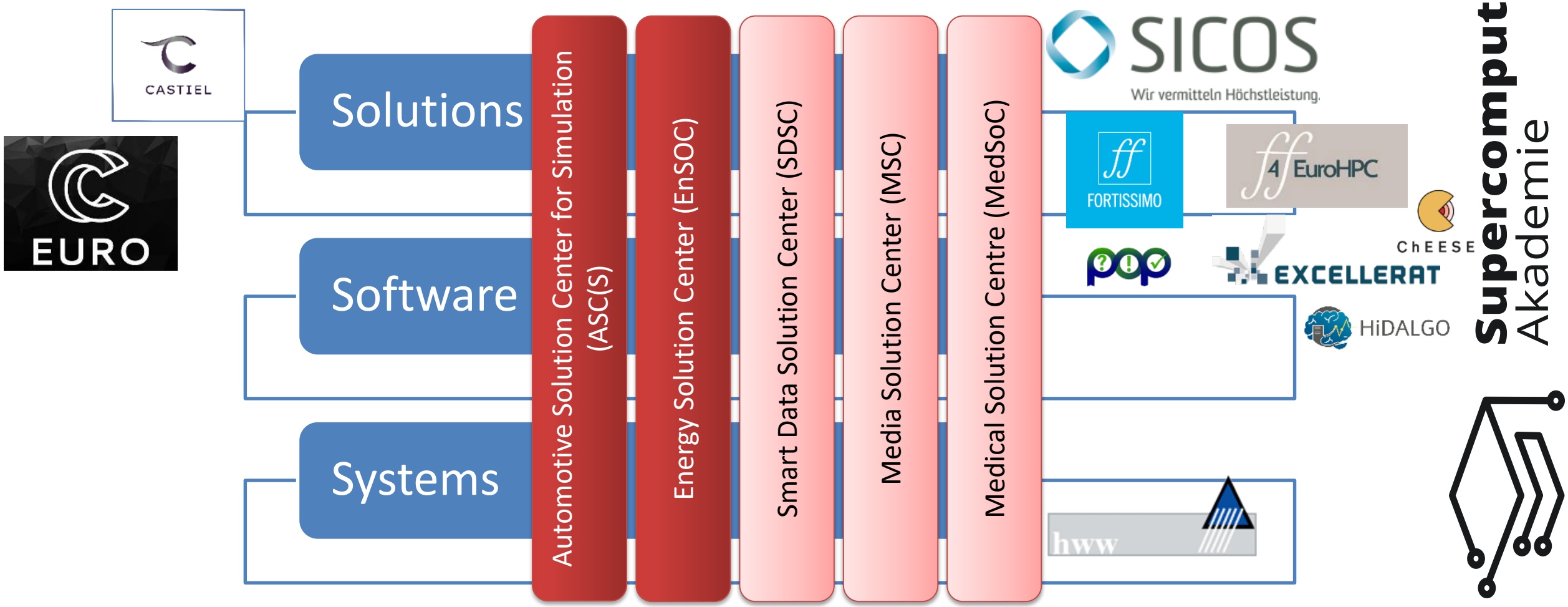
Focus
SMEs/Engineering/Automotive

Issues

- **Topics**
  - Energy
  - **Climate Change & The Environment**
  - Health & The Aging Society
  - **Mobility in the 21st Century**
  - Digital Societies
- **Technologies**
  - **AI/Data to Solution (D2S)**
  - Cyber Security
  - **High Performance Computing**
  - Green-IT
- **Customer Base**
  - Research
  - **Industry**
  - Public Agencies



Strategic Setup

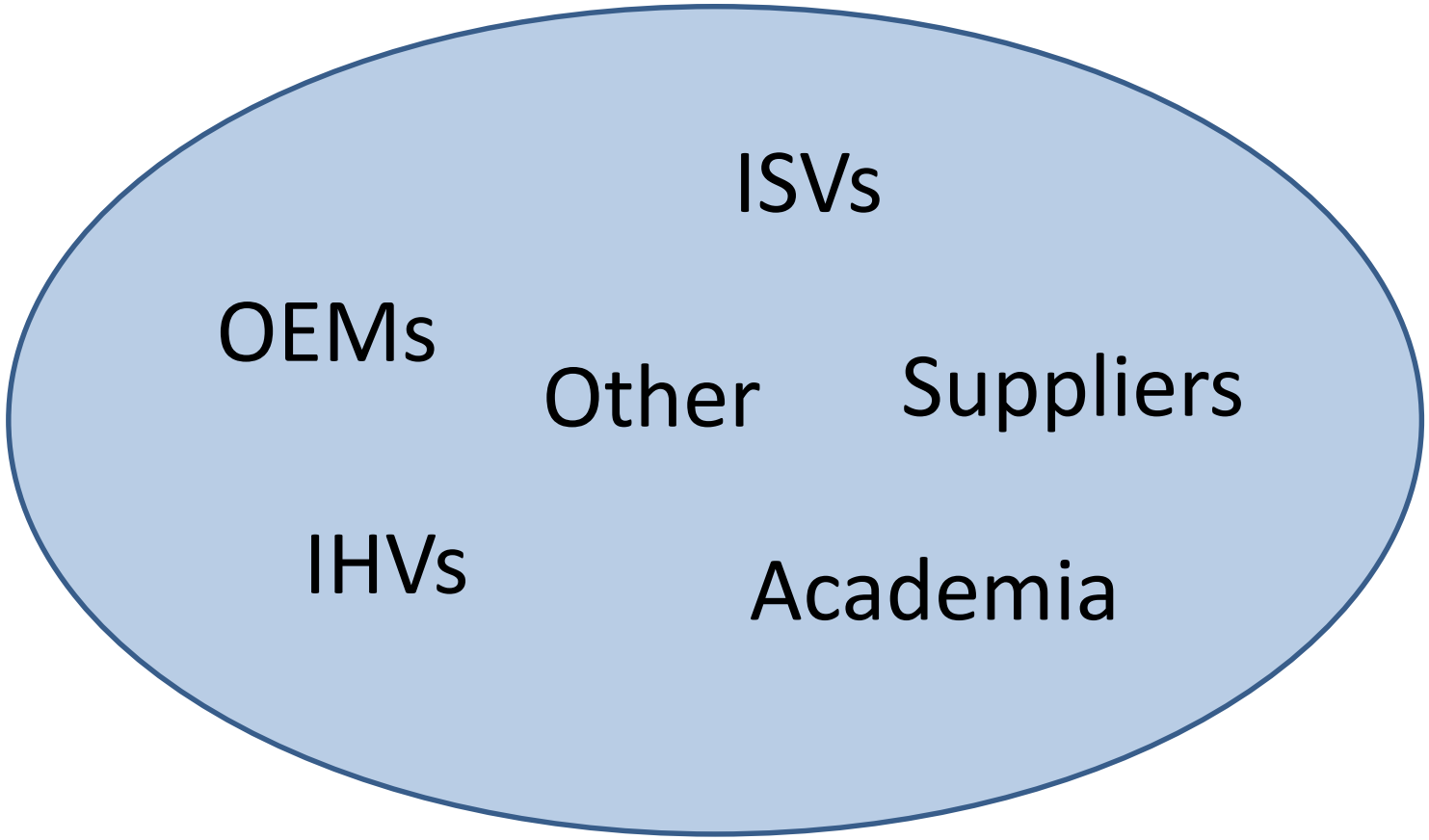


How to deal with the different aspects

Automotive Solution Center for Simulation

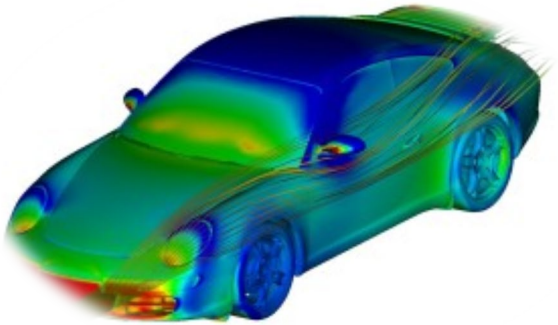
- ASC(S is a non-profit association for know-how carriers in the field of automotive simulation
- Brings together the players needed to evolve automotive
- HW & SW of interest
  - Work on common challenges in a pre-competetive environment.

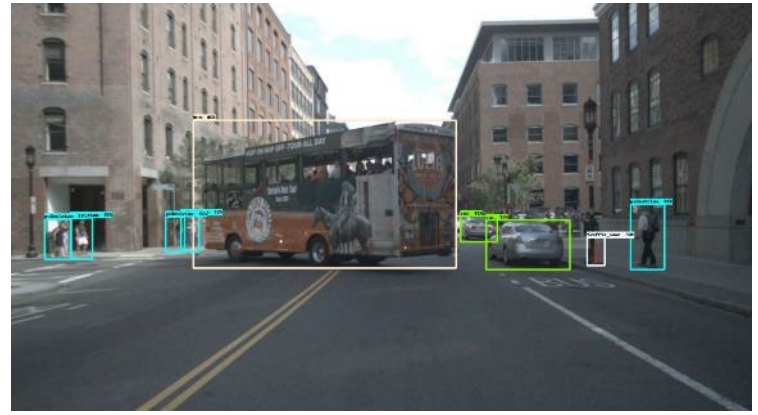
Automotive and Engineering (more than just big companies)



What are their application fields

- Classical development of vehicles
  - Shapes, interior, crash simulations…
- Autonomous driving
  - Image recognition and processing
  - Virtual testing and validation
- Fleet Management
- …
- In general move from „classic“ HPC to HPC+
  - HPC+ = HPC and associated technologies (AI, HPDA…)
  - But on different levels and depending on what the aim is
  - Quantum is of interest, but needs to be mature and reliable as technology





Current: SW

- SW (available at HLRS - https://www.hlrs.de/solutions/software)
  - Focus on ISV codes (examples)

Computational Fluid Dynamics	Ruopp Zhang	Please note the specific license and usage conditions for commercial codes		
STAR-HPC	CD-Adapco	available		Universität Stuttgart members only, noncommercial use only
STAR-CCM+	CD-Adapco	available	available	Universität Stuttgart members only, noncommercial use only
Ansys	ANSYS	available	available	noncommercial use only
OpenFOAM	OpenFOAM	available	available	no user restrictions (Open Source Software)
Computational Structural Mechanics	Bernreuther	Please note the specific license and usage conditions for commercial codes		
ABAQUS	Abaqus	available	available	Universität Stuttgart members only, non-commercial use only
Ansys	ANSYS, CADFEM	available	available	Universität Stuttgart members only, non-commercial use only
MD FEA Bundle (Patran, Nastran, Marc, Sofy)	MSC Software	available	available	Universität Stuttgart members only, non-commercial use only
LS-Dyna	LSTC, Dynamore	available	available	Universität Stuttgart members only, non-commercial use only
Permas	Intes	available	available	not available at the moment

Goals for HLRS

Current: SW

- Problem: ISVs move slowly.
  - Example: HDR200 with newest MOFED stack leads to issues with actual MPI Implementations as ISV codes do not support yet new features and rely on old versions of MPI and Operating Systems
  - Leads to overheads because of necessary workarounds
- Automated optimization is desired

Future: SW

- Stronger focus on uncertainty quantification
  - Needs improved data analytics (more AI, more ML…)
- Future use cases
  - Fleet management, predictive maintenance….
- General:
  - ISV codes need to run on the hardware
    - Elaborated software ecosystem
    - Compiler, etc…

Current Hardware HLRS HPE “Hawk”

- HPE Apollo 9000
  - Technology
    - 720.896 cores 2nd Gen AMD EPYC “Rome”
    - 1,44 PB Main Memory
    - ~26 PetaByte Disk
  - Performance
    - ~26 PetaFlops Peak
    - >2 PetaFlops Sustained
  - Network connectivity
    - Intern 200 Gbit/s
    - Extern 100 – 800 Gbit/s

Current: HW – HAWK Extension

- HLRS „Hawk“ Extension Q2/2021
  - 24 HPE Apollo 6500 Gen10 + systems
  - 192 NVIDIA A100 GPUs
  - ~120 Pflops AI Performance
  - Extension of the hybrid HPC/AI research activities

Current HW:

- Industrial Cluster: Zoo of different X86_64 partitions
  - Pre- and Postprocessing (big memory)
  - Different Processor Types with a variation of cores and memory
  - Visualisation nodes (GPU)

Future HW:

- More AI/HPDA HW needed
  - X86_64 will be still in the focus
  - Accellerators will get more important
  - All Architectures of interest which will support ISV codes, compiler, etc….
  - Multiple architectures of interest, if the burden of porting is low
  - Automotive wants to have secured HW in secured environments
    - No playground for scientists

HW/SW what else?

- Automotive/Engineers needs a complete EcoSystem!
  - Data transfer (secured)
  - Training (e.g. Supercomputing Academy)
  - Complex Workflow management
  - Security in general (e.g. TISAX, ISO27001)
    - Can also have an impact on HW/SW!

Summary

- The Automotive Ecosystems builds on top what can be bought
  - Needs to be proven
  - Needs to be mature
  - Needs to provide the ecosystem for their way of using it
- Automotive looks into new/other technologies
  - Not aiming for immediately having newest technology if not a clear benefit and maturity are convincingly presented
  - Long term identification on what the pros/cons of a technology changes are
- General openness ist there, but requires to clearly show benefits

THANK YOU! QUESTIONS?