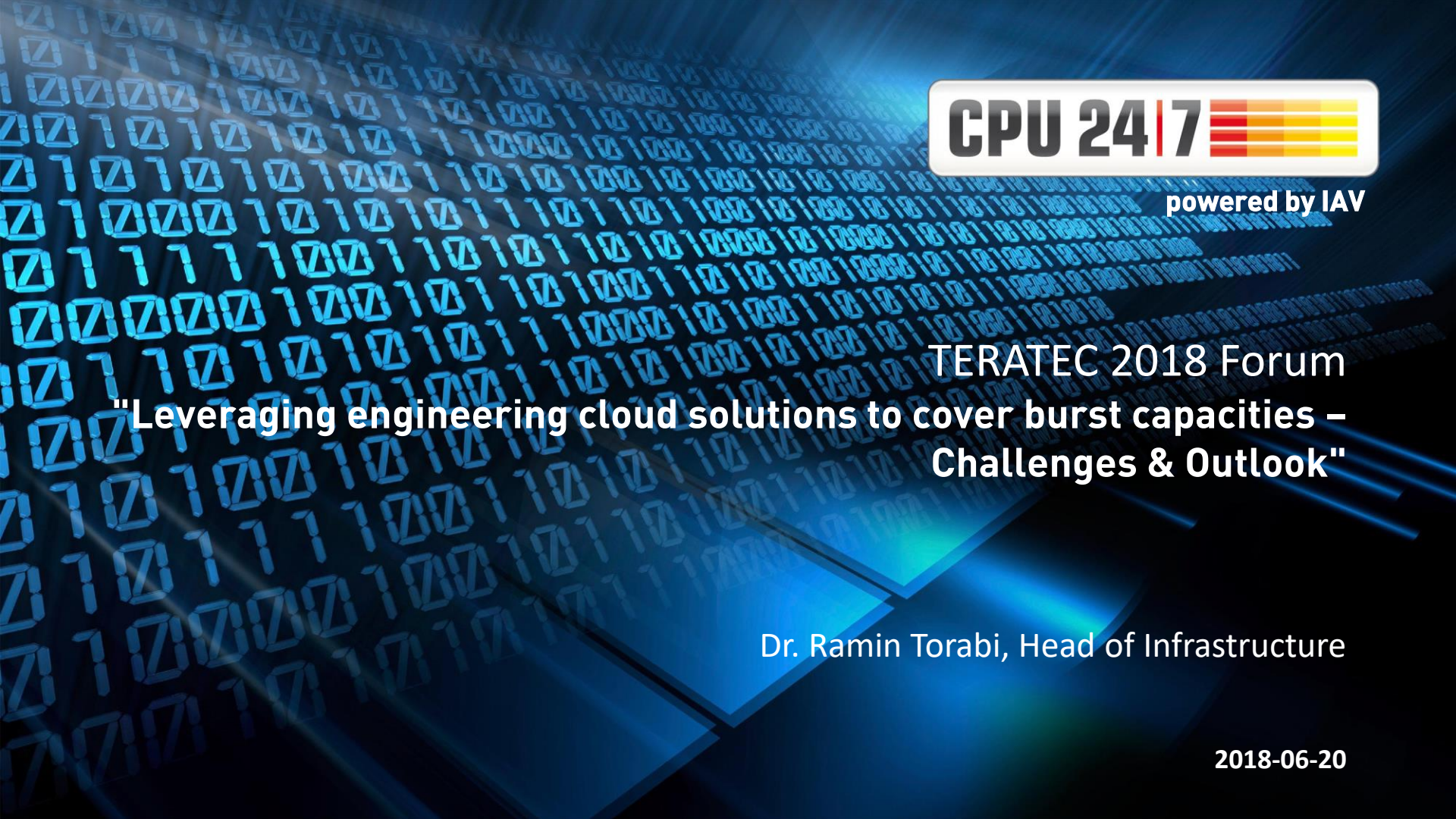


TERATEC 2018 Forum

"Leveraging engineering cloud solutions to cover burst capacities – Challenges & Outlook"

Dr. Ramin Torabi, Head of Infrastructure

2018-06-20

Hi everybody!

Dr. Ramin Torabi, Head of Infrastructure

IT Services

Operations and DC

CAE/HPC

Agenda

1. Engineering cloud market
2. Targeted user groups of engineering clouds
3. Licenses – a real challenge of engineering clouds
4. Technical view
5. Wrap-Up & Outlook

1. Engineering cloud market

About CPU 24/7

1 IT Service Provider

for Cloud-based High Performance Computing

2 Focus Engineering (CAx)

Specialized in applications and Engineering Workflows

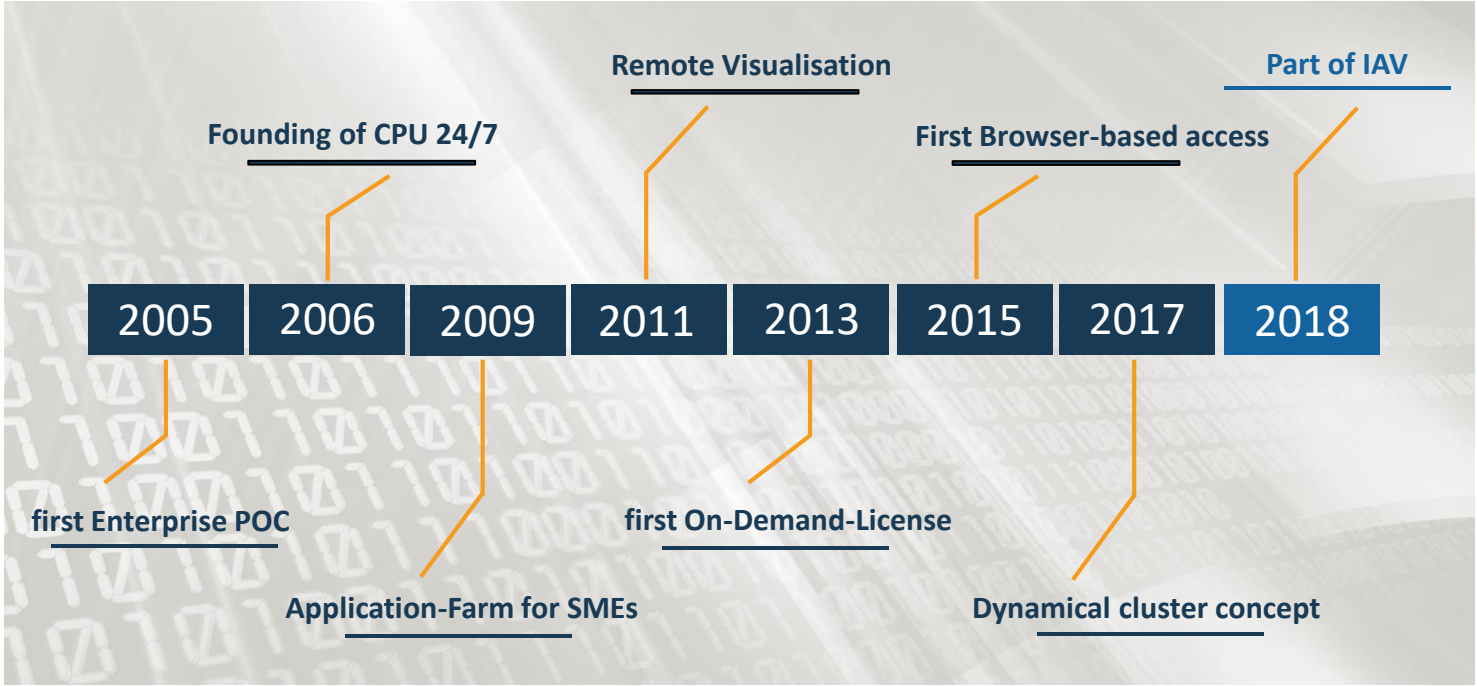
3 Full-Level-Service und Support

Individual and personal

HOSTED IN **GERMANY**

SECURITY
SERVICE
PERFORMANCE

CPU 24/7 – more than 10 years of innovations for satisfied customers

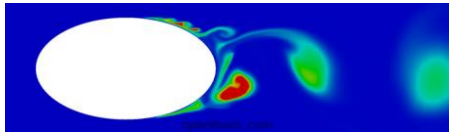


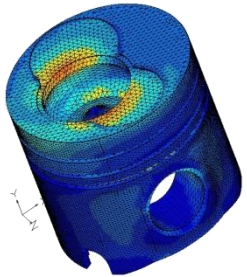
References and customers

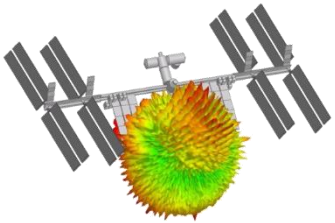
Partners and key technology providers

Exemplary CAE applications for cloud workload

- CFD (fluid flow)
- Crash / deep drawing
- Structural analysis
- Durability analysis
- Acoustics (NVH)
- Ray tracing
- Electro-magnetics
- Combustion chemistry
- Material science





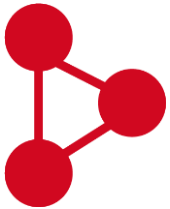


Top 3 major challenges in today's engineering

Complexity

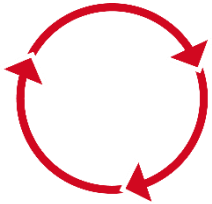
- Organisation
- Collaboration
- Simulation models

Resources



- Desktop vs. Workstation vs. Inhouse Cluster
- Budget
- Know-how

Flexibility & Agility



- Development Cycles
- Licensing
- Unpredictable Demands

2. Targeted user groups of engineering clouds

CAE as a Service – 3 targeted user groups

SINGLE USER

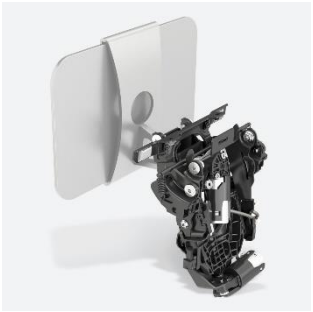
CLOUD BURSTING

ENTERPRISE CLOUD

~ 16-132 cores for temporarily usage	~ 32-250 cores temporarily outsourced	>>1000 cores outsourced
~ 2h - 30 d	~ 30 -180 d	~ 1- 3 y

Why Brose Group uses HPC resources on CPU 24/7

brose
Technik für Automobile



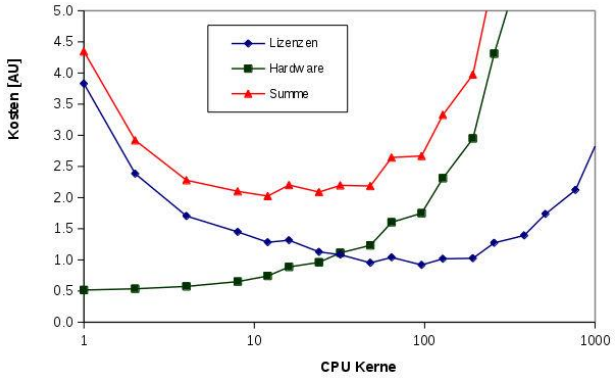
> "The number of necessary computing procedures is subject to significant – and sometimes spontaneous – fluctuations, which is why demands on computing resources are difficult to plan. To cope with internal HPC server peak loads we chose CPU 24/7."
>
> Thomas Resch, Head of Simulation, Brose Group

3. Licenses – a real challenge of engineering clouds

Licensing of CAE solvers

- Licensing models
  - by thread (Powerflow, StarCD, Pam-Crash)
  - by a function of the threads (Ansys HPC-Pack, Abaqus)
  - independent of threads (site, campus, per job, open source)
  - by simulation type
  - for enabling GPU usage
- Timeframe
  - yearly, quarterly (hourly would be “cloud ready”)
  - how quickly can licenses be obtained (typically within a few months)
- License optimization
  - License model
  - License/HPC price
  - Benchmark results

ANSYS DYNA MORE CD-adapco COMSOL esi get it right®



Current status – lack of real cloud licence agreements!

Bring your own license

Mostly possible

License Management

Rarely implemented

On-demand & pay per use

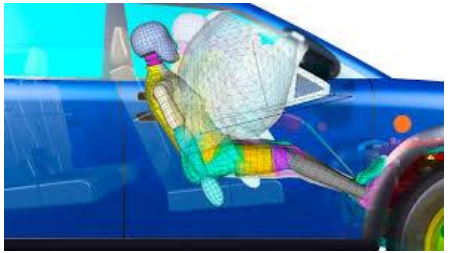
Very rarely

4. CAE aspects and challenges

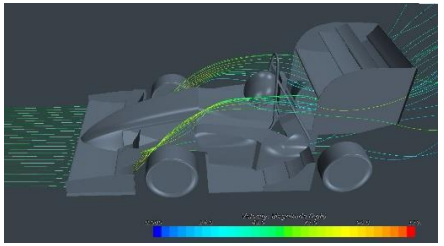
CAE applications – typical bottlenecks

MBW – memory bandwidth
MLT – memory latency
FLOPS – Floating point operations per second
LLI - low latency interconnect
IOPS – IO Operations Per Second

- FEA
  - explicit (crash / deep drawing) → MBW + FLOPS + LLI
  - implicit (structural / durability)
    - CPU Frequency, memory capacity + MBW + LLI
  - frequency analysis (lanczos)
    - single node (local) IOPS
    - eg. Nastran reads matrices/files backwards



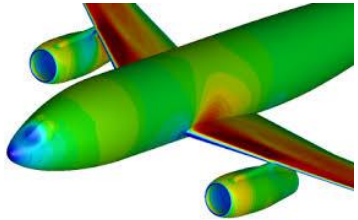
- CFD
  - stationary → MBW + LLI + FLOPS
  - in-stationary → IOPS and IO capacity and robust systems
  - dynamical mesh → requirements change during simulation



- HPC systems tailored to customers needs
  - CPU, RAM, File System, …

Multiphysics simulation: Coupling issues

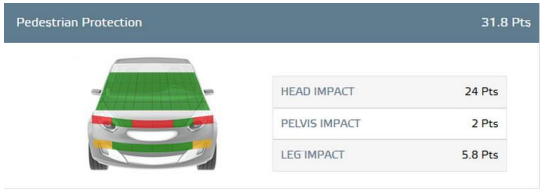
- Two or more solvers are running simultaneously (or sequentially) and influence each other
  - Plane wing
  - Underhood / head lamp
  - Car to car crash

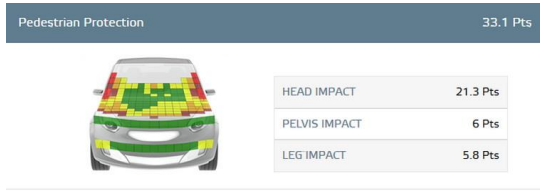


- Different hardware
- Different licenses

CAE optimisation / variation

- Topology optimisation
- Taking different variances in production into account
  - thickness
  - composition
  - welding





What does that mean for operations?

- Many simulations required
- Advantages due to workload automation

Engineering cloud challenges | operations view

1 Dynamics

- dynamical secure separation of customer clusters and data
  - networks
  - storage
  - nodes

2 Performance

- maintaining bare-metal performance (latency bandwidth)
  - Interconnect
  - Memory

3 Data gravity

- obstacle for new customers
- remote visualisation
- automation

4 Physical separation

- complete physical separation of network devices implies rewiring
  - slow and expensive

5. Outlook

Outlook – Top 3 hypotheses

1. In 2030 every engineer will use simulation.
2. There will be no way around cloud solutions.
3. Pay per use will be standard for hardware & licenses.

Wrap up: Why engineering clouds solve most of CAE issues?

- Increase flexibility/availability of hardware and software
- Minimising risks
- Gain from Expertise
- Up-to-date infrastructure
- Faster results

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Q & A

Teratec 2018 Forum

"CAE cloud burst ... "

Dr. Ramin Torabi

Portfolio of different CPU 24/7 projects