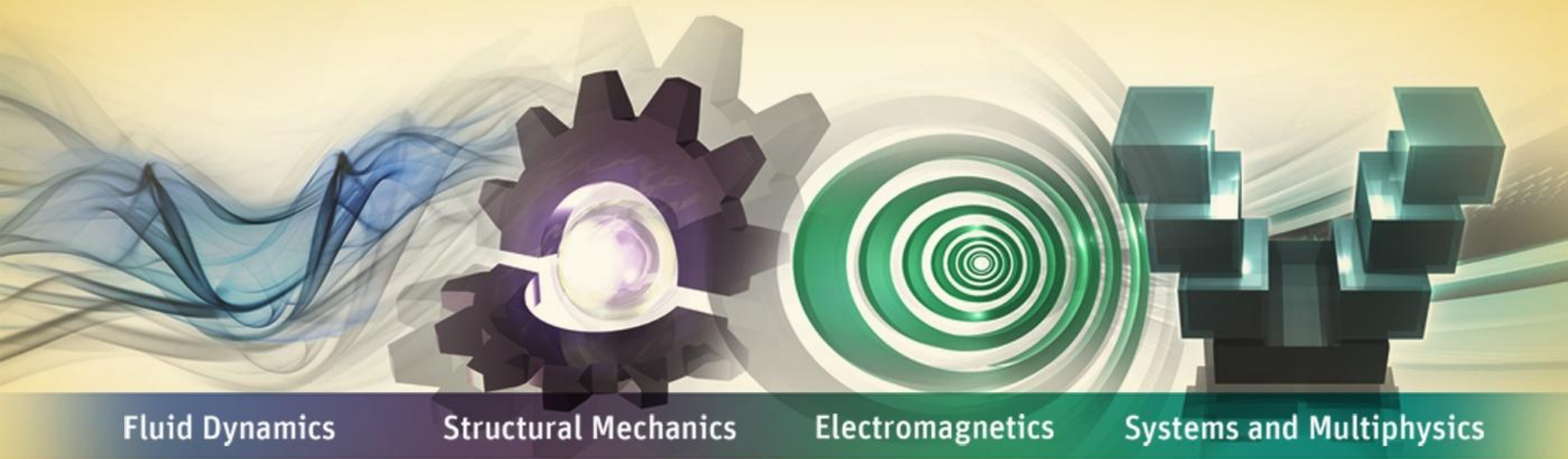


Optimizing IT Deployment Issues

Trends and Challenges for Engineering Simulation



Fluid Dynamics

Structural Mechanics

Electromagnetics

Systems and Multiphysics

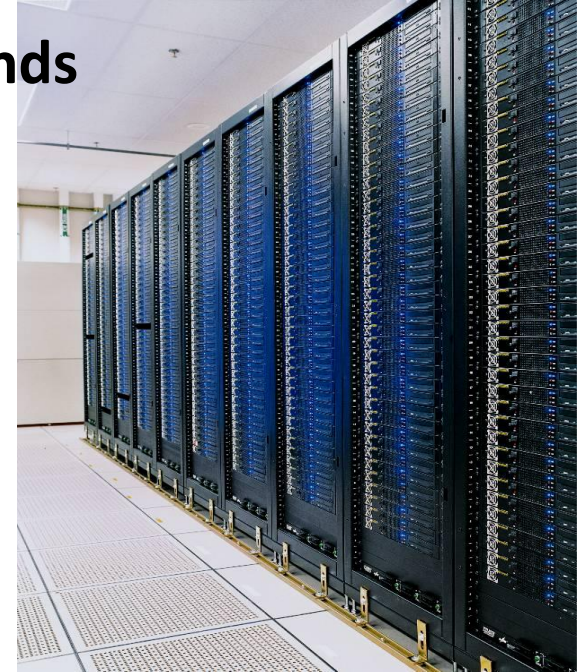
Barbara Hutchings

Director of Partnerships / HPC Strategy

barbara.hutchings@ansys.com

Deployment of Simulation - Challenges and Trends

- Extreme scale up and scale out
- Enterprise deployment / remote access
- Cloud computing

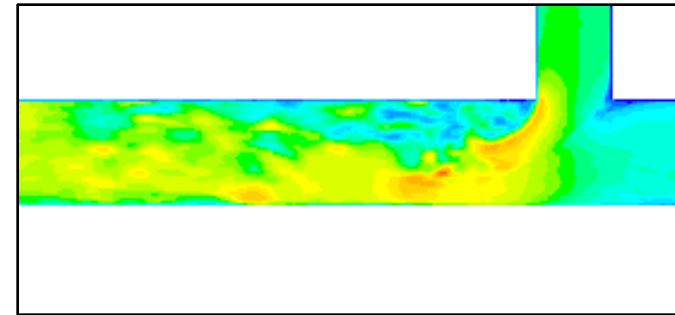


Infrastructure for Extreme Fidelity

Simulation allows engineering to know, not guess – but only if IT can deliver dramatically scaled up infrastructure for “mega” simulations.

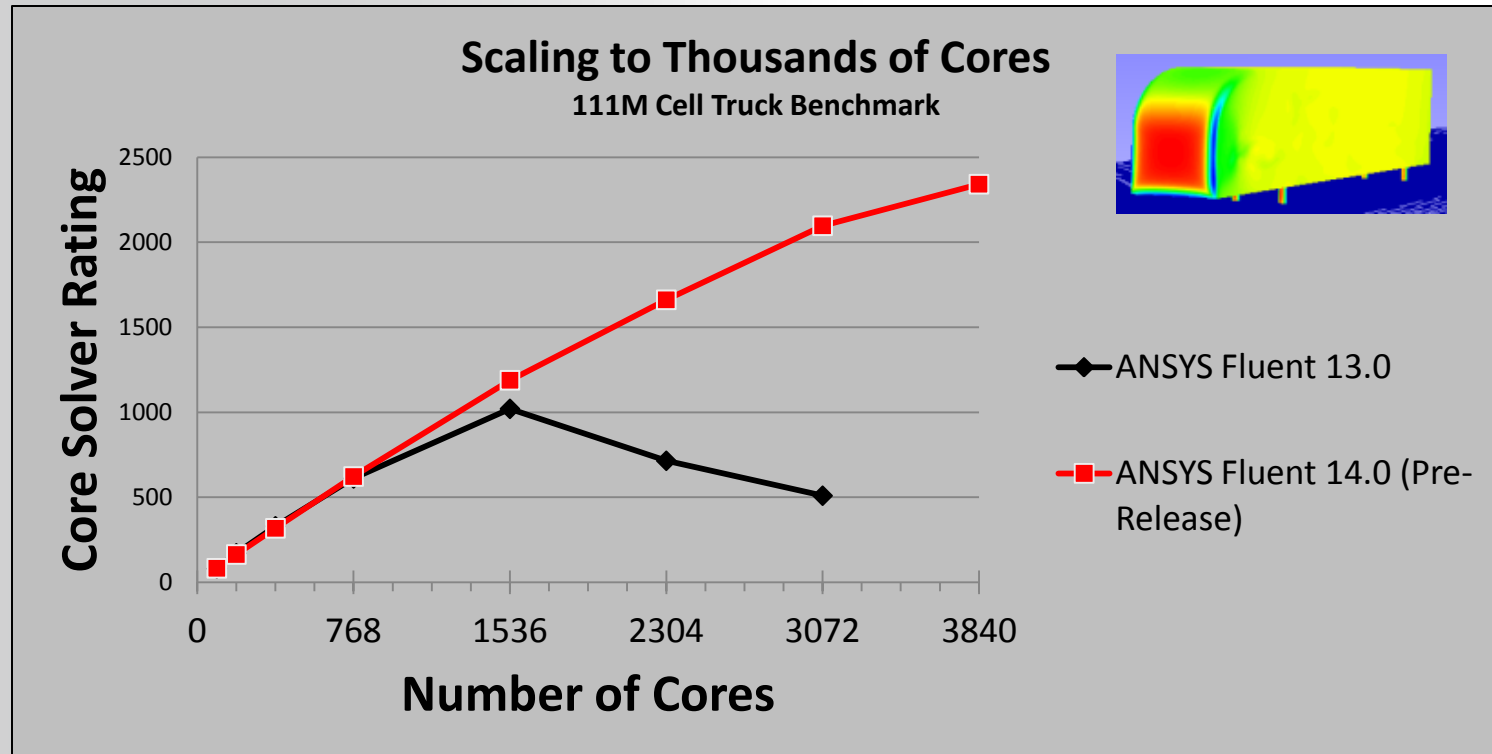
IT asked to deliver

- **Memory capacity for 1B cell models (1 TB RAM)**
- **1000s of cores per mega simulation**
- **Data storage for files in excess of 1 Tbyte**
- **Scale-out licensing (e.g. ANSYS HPC Packs)**



LES Fluid Mixing
160M cell model
1000 core HPC
Linköping University, SWEDEN

Extreme CFD Scaling - 1000's of cores



Enabled by ongoing software innovation

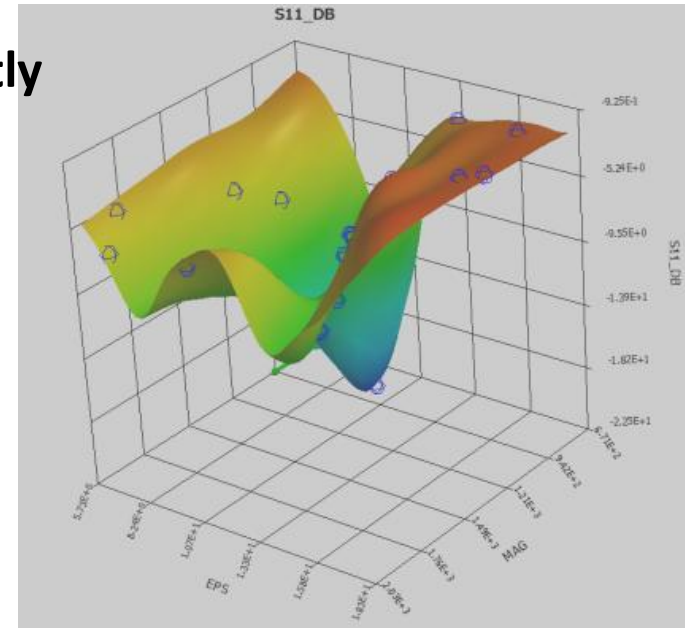
Hybrid parallel: fast shared memory communication (OpenMP) within a machine to speed up overall solver performance; distributed memory (MPI) between machines

Infrastructure for Design Exploration

Product integrity requirements imply using simulation for robust design and optimization, which increases simulation workload by 100x

IT implication is profound “scale out”

- Access to 100x HW capacity, perhaps intermittently
- Job automation
- Failure recovery and high availability
- Network bandwidth and extreme data load
- Licensing for 100x workloads



Enterprise Deployment of Simulation

Local computing infrastructure for simulation is being replaced by centralized HPC resources, shared by a globally distributed workforce.



Enterprise Deployment of Simulation

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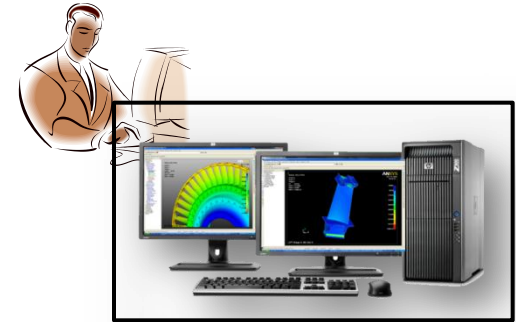
IT-related challenges

- Fail-proof enterprise licensing
- Controlled SW version updates; backward compatibility
- Job scheduling/prioritization
- Remote interactive access and remote visualization tools
 - Critical, given file size and transfer time
- Data sharing by distributed work teams; data management

Simplest Levels of Remote Access

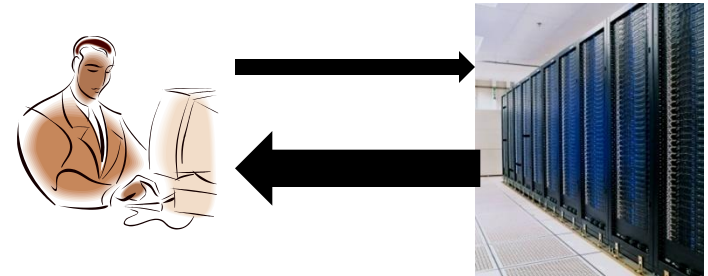
Local Computing

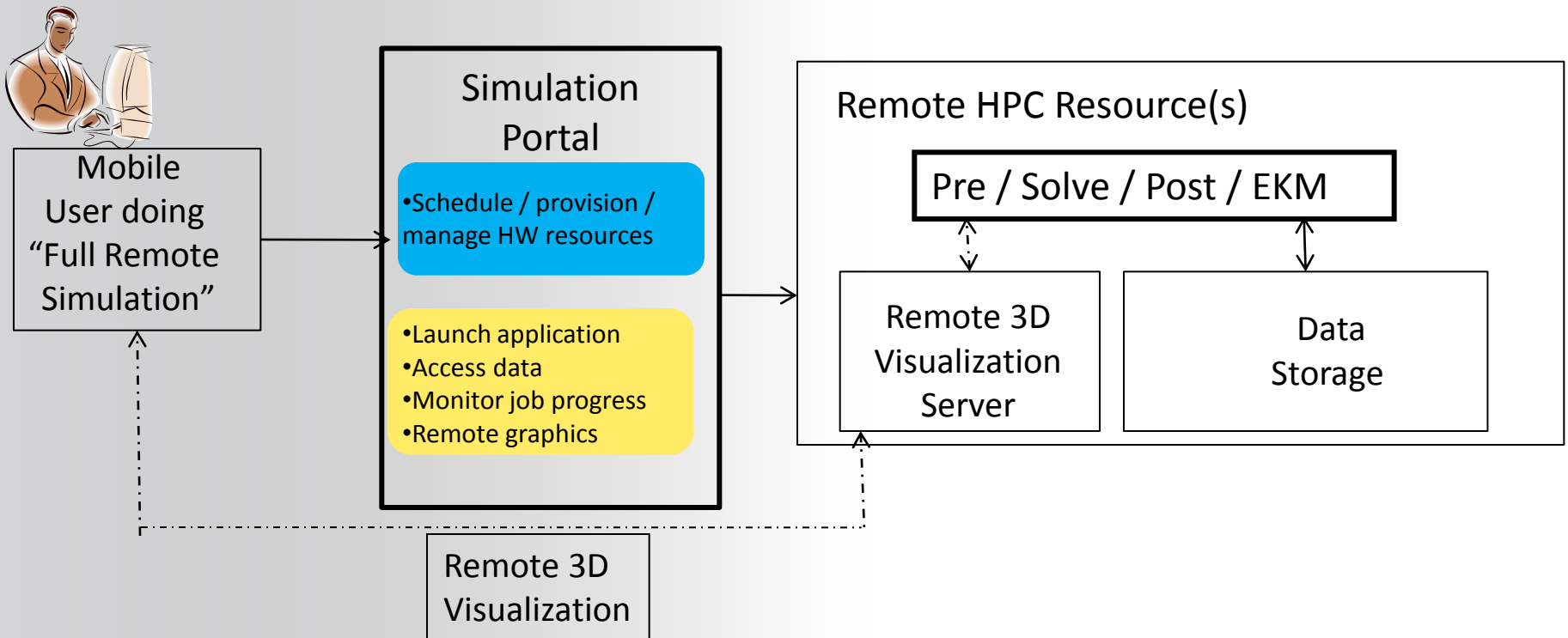
- Pre / Solve / Post on local desktop system
- Files stored locally under individual control
- Inherent capacity limitations; also limits collaboration and data management



Remote Batch

- Pre / Post on local desktop system
- Batch solve conducted on 'remote' HPC resource
- Bottlenecks related to file transfer and limitations of local hardware (e.g., can't postprocess large files on local machine)
- Remote access and job management also challenging.





- **Files reside at the HPC resource – for efficiency, enhanced data management, collaboration**
- **Full simulation process conducted via remote access (Pre/Solve/Post)**
- **Feasible and implemented today by best-in-class**



Cloud = remote access to elastic infrastructure

- Scale up compute capacity and data storage, intermittent workloads
- Private cloud (internal elastic provisioning) or outsourced HPC on public cloud

But challenges remain for

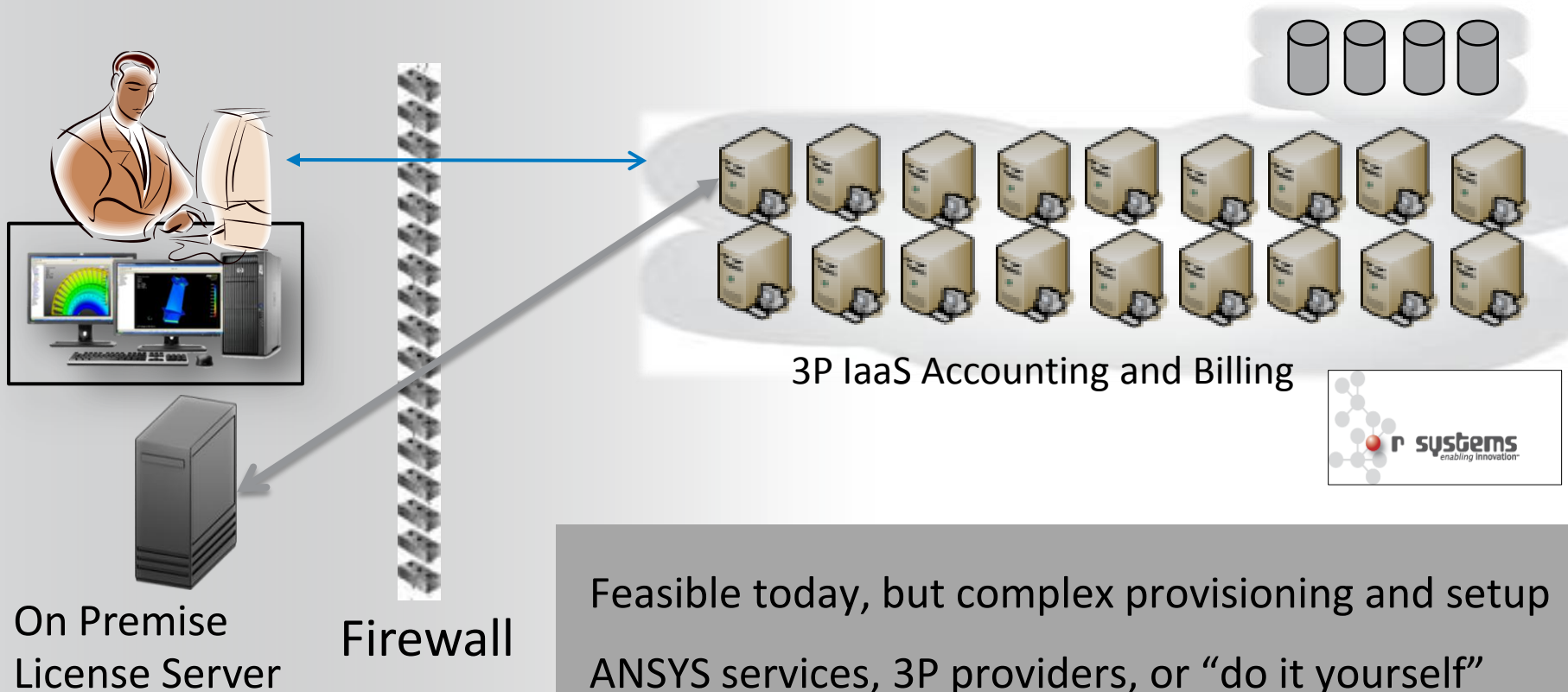
- Remote workflow (file transfer, visualization, remote interactive access)
- IP protection, export compliance and data sharing
- Optimized use of on-premise vs. “remote” systems

ANSYS focus

- Improved remote simulation workflow
- Enable / encourage seamless use of remote (or 3P hosted) hardware
 - “Bring Your Own License” model

Hosted or Public Cloud for HW Outsourcing

Do It Yourself IaaS / “Bring Your Own License”



Feasible today, but complex provisioning and setup ANSYS services, 3P providers, or “do it yourself”

“Take Home” Points / Discussion

IT infrastructure is “mission critical” for extracting high value from simulation

- **Key emerging strategy topic for ANSYS and for our customers**

Scalability for next generation simulation workloads is key

- **Scale Up and/or Scale Out**

Enterprise deployment and cloud computing share technical challenges

- **Remote interactive access and visualization, data management, IP protection**

Comments / Questions / Discussion