



Powering Innovation That Drives Human Advancement

Maximizing HPC Efficiency for Ansys Simulations: Addressing Critical IT Concerns with Slurm Resource Management and Scheduling

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Slurm User Group
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Agenda

- Brief introduction to Ansys
- HPC at Ansys
- Conclusion
 - Lessons learned
 - HPC Trends



Brief Introduction to Ansys

Introduction to Ansys



Energy



Defense



Healthcare



Automotive
Transportation & Mobility



Industrial Equipment



High Tech



Aerospace

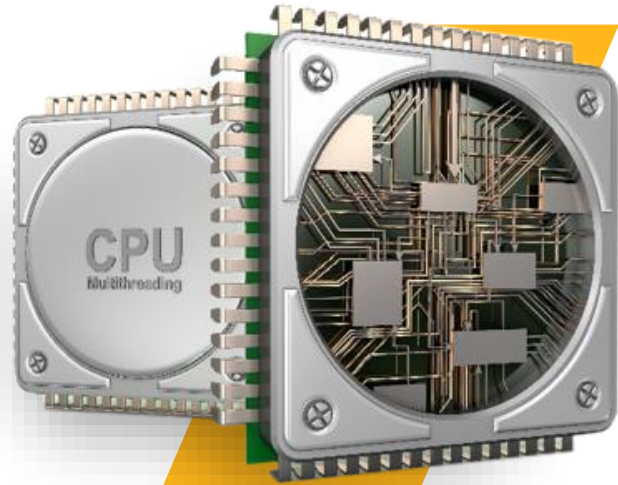
Founded 1970
CAE/multiphysics engineering
simulation software
President: Ajei Gopal
Employees: 6,300 (2024)
HQ: Canonsburg, PA, USA
2023 Revenue: \$2.27 B USD



Ansys simulation of a 3 cars collision

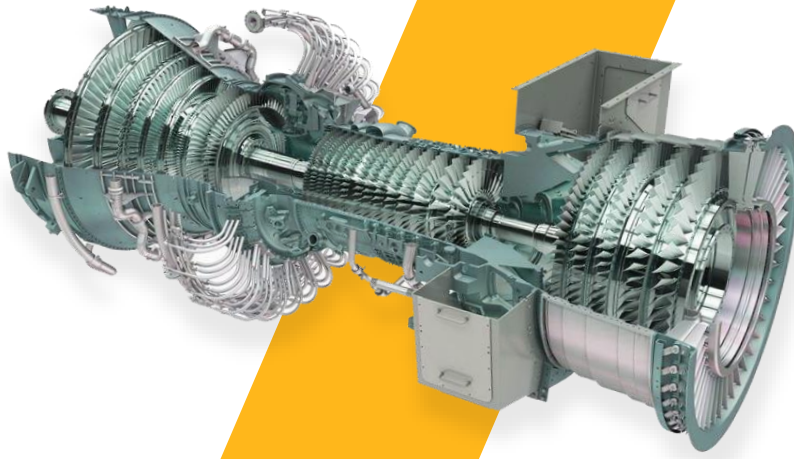


Increased pressure to deliver on the classic challenges



30%

Time-to-market



2 YEARS

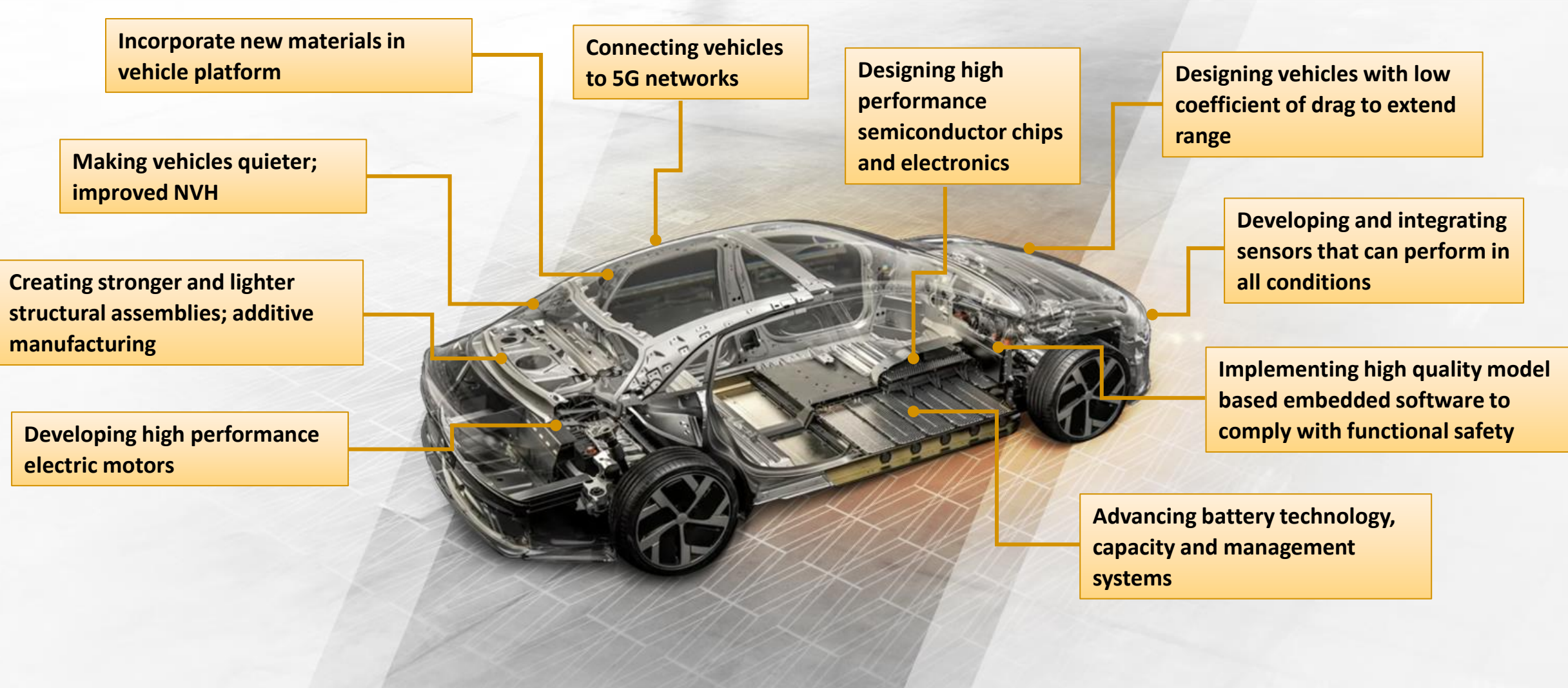
Cycle times



66%

New product rollouts

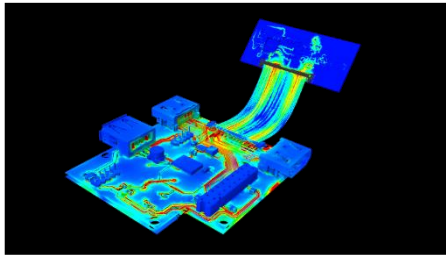
Strong need for faster innovation with better outcomes at lower costs



Ansys 5 pillars of innovation

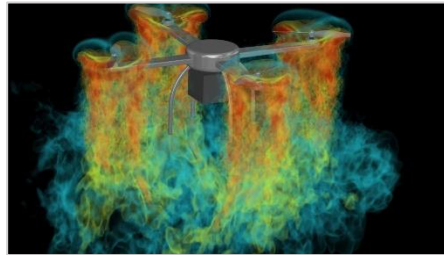
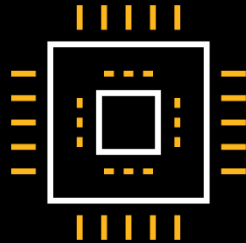
Driving your greatest innovations and solving your toughest challenges

NUMERICS



Multiphysics, multi-scale, connected workflows

HIGH-PERFORMANCE COMPUTING



Multiple products leveraging GPU for solver acceleration

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING



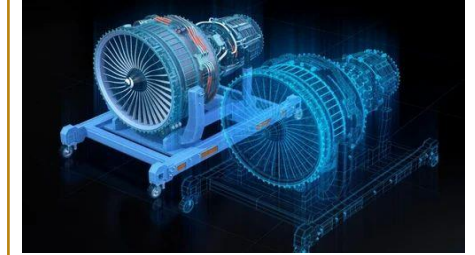
More than a half-dozen products leveraging AI/ML

CLOUD AND EXPERIENCE



Fast, flexible and scalable for every user

DIGITAL ENGINEERING



Model-based systems engineering, digital twins, SPDM

/ CLOUD OFFERS

Cloud Marketplace – BYOC

Ansys Gateway powered by AWS™

Ansys Access on Microsoft Azure™

Software as a Service (SaaS)

Ansys SimAI™

Ansys ConceptEV®

PRODUCT CAPABILITIES

Cloud Connected

 Storage

 Burst Compute

 Collaboration



HPC at Ansys

HPC at Ansys

- Our customers' goals
- Deployment models: Cloud and On-premises
- Nature of Ansys HPC simulation jobs
- HPC IT goals to address customer goals
- Challenges and solutions
- Observability of HPC Simulation jobs



Our Customers' IT Simulation Goals

- Available HPC infrastructure to run large models with billions of cells
- Minimum wait time to submit jobs
- 'Fair' distribution of available HPC infrastructure
- Efficiency of simulation results (post processing analytics)
- Proper VDI (Virtual Desktop Interface) support
- Tackle longer transients and more complex physics in hours rather than in days of solve
- Reduce time with GPU computing
- Run multiple simulations in parallel
- Get higher-fidelity insight into how designs are going to work in the real world
- Container support

Our Customers

Ansys Fluent®
Semiconductor
Ansys Mechanical™
Ansys LS-DYNA®
Ansys Dynamore™
Ansys Lumerical™
Ansys Speos®
Others..

HPC deployment models to support customer simulation needs

Deployment 1: Multi-core desktop computer



- Usual starting point for most accounts, and most common deployment model
- Mostly Windows-based hardware with its own compute, storage and graphics
- Hardware characteristics:
 - Up to 10+ CPU cores
 - Up to 128 GB of RAM
 - 1 GPU
- Pros:
 - Good capability for pre- and postprocessing
 - Good performance for most Mechanical, HFSS and Maxwell applications (except for DOE studies)
 - Relatively easy to maintain by end user
- Cons:
 - Lack of performance for most Fluent and LS-DYNA applications
 - Tedious to maintain by IT in case of many other desktop computers
- HPC/hardware partners:
 - Dell, HP Inc., Lenovo, Supermicro, BOXX, Exxact Corp, Gen X, KOI Computers, 2CRSI

Deployment 2: Multi-node server



- For accounts having multiple concurrent simulation users
- Mostly Linux-based hardware with remote storage, and graphics via Windows desktop computer
- Hardware characteristics:
 - Up to 10s of CPU cores
 - Up to 1TB of RAM
 - Up to 4 GPUs
- Pros:
 - Good performance for computational demanding products like Fluent and LS-DYNA
 - Affordable, scalable/expandable systems once computational demands or group of users increases
- Cons:
 - More complex to size, configure and maintain (but SIs among our HPC partners do help)
 - Challenging to meet both high fidelity and throughput demands for Fluent and LS-DYNA workloads
- HPC partners:
 - Hardware: HPE, Dell, Lenovo, Fujitsu, Supermicro, 2CRSI
 - SI for HPC: GNS Systems, Nor-Tech, TotalCAE, X-ISS

Deployment 3: Datacenter



- For relatively large accounts with geographically distributed users
- Linux-based hardware with fast storage, compute and visualization nodes; despite use of VDI, often combined with desktop computer for interactive workflows
- Hardware characteristics:
 - More than 1000 of CPU cores
 - More than 1TB of RAM
 - More than 10 GPUs
 - Up to 400 Gbps network bandwidth
- Pros:
 - Adequate hardware capacity for both high fidelity and high throughput demands for Fluent and LS-DYNA workloads
 - Good IP protection and process traceability
- Cons:
 - Significant upfront CapEx required
 - Most complex to size, configure and maintain (but HPC OEMs and SIs among our HPC partners do help)
 - Challenging to meet intermittent workloads and heterogeneous workload requirements
- HPC partners:
 - Hardware: HPE, Dell, Lenovo, Fujitsu, 2CRSI
 - SI for HPC: Atos, GNS Systems, Nor-Tech, OCF, TotalCAE, X-ISS

Deployment 4: Cloud



- For SMB accounts lacking IT staff, hardware and CapEx; for Enterprises where in-house HPC is at max capacity and cloud is a corporate initiative
- Usual compute-optimized or memory-optimized Virtual Machine (VM) instances; sometimes bare-metal instances
- Hardware characteristics:
 - Virtually unlimited capacity with 10,000s of CPU cores (from Intel, AMD or ARM), and GPU cores (from Nvidia, AMD)
 - Up to 1TB of RAM per node/instance
 - Up to 200 Gbps network bandwidth (e.g., AWS' Elastic Fabric Adapter)
- Pros:
 - Optimal for meeting intermittent workloads and heterogeneous workload requirements
 - Removal of IT barriers (i.e., no need to maintain the hardware and software; access to the latest generation of powerful hardware; hardly any upfront investment; access to HPC experts and data security specialists)
- Cons:
 - Data security is sometimes inadequate for customer's needs
 - Costs are relatively high compared to that of on-premises hardware at ~80% utilization
- Cloud partners:
 - CSP: AWS, Azure, GCP, and OCI
 - CHP: Atos/Nimbix, Rescale, UberCloud, Gridcore, Penguin Computing, Syncious
 - SI: Atos, Kalypso, Nextira, science+computing, Transition Technologies

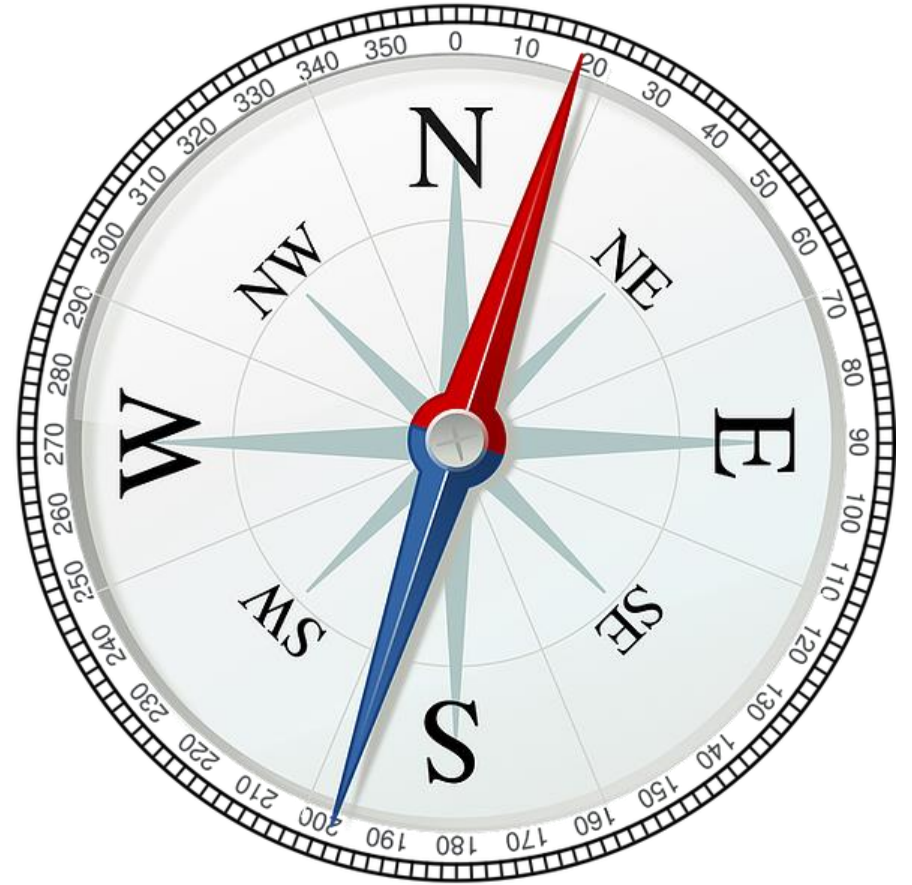
Nature of Ansys Simulation jobs

- Different approach to memory and cores
- Different usage of GPUs
- Good neighbor vs bad neighbor (can/cannot run in same partition)
- Different solvers
- Storage access
- IO utilization



HPC IT goals to address customer needs

- Observability
- Shared resources
- Cost management
- Research and innovation
- Performance improvement
- Transparency and accountability
- BU alignment and cross-BU resource harmonization



HPC Challenges and opportunities

- Observability and performance awareness (network, compute, storage)
- CPU core and memory allocation, utilization, and efficiency
- Cost overruns for cloud-based simulation jobs
- Automation

Observability for our HPC environments

- Slurm Accounting database
- Native observability commands (sinfo -R -o)
- Slurm Exporter for Prometheus
- Grafana
- XDMoD
- ServiceNow Audit Tests (nodes, partition, clusters)
- Cloud HPC costing data

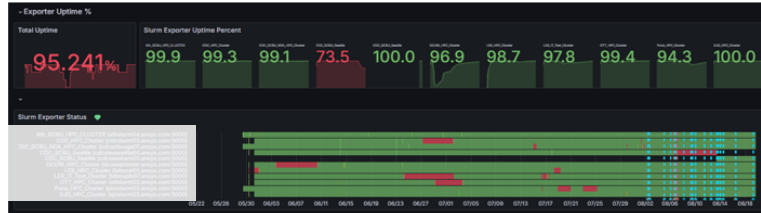


Observability

Observability with Slurm Exporter

If Slurm Exporter is down, reporting integrity is compromised:

1. Cluster allocation
2. Cores allocation
3. Nodes allocation
4. Job wait time

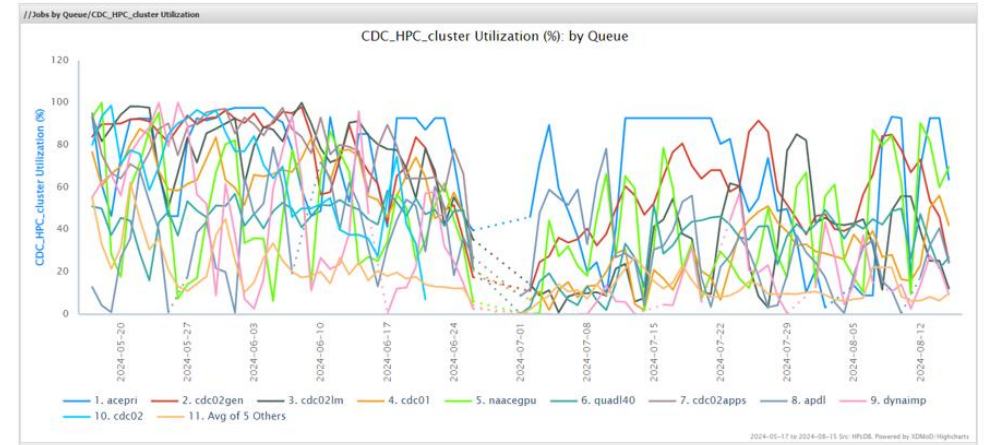


Slurm Exporter downtime is monitored as Level 2 operational metric.

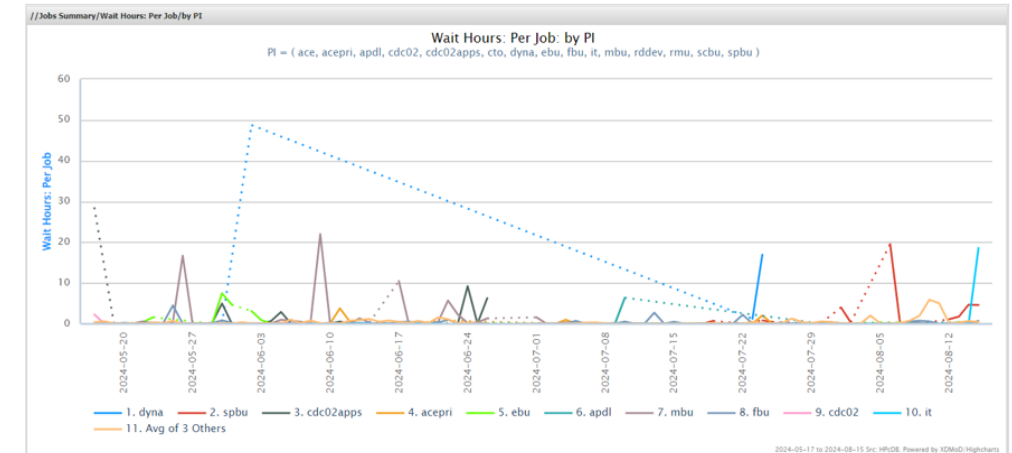
Observability with Grafana dashboards – Cloud vendor A – Costing



Observability with XDMoD: Partition Utilization – all partitions



Observability with XDMoD: Wait time by Principal Investigator





Lessons learned

HPC IT Lessons Learned

- Listen to our customers and our customers' customers
- Identify sources of truth via telemetry
- Adopt SRE principles: SLOs, Monitor, Automate, Release Engineer, Simplicity, Embrace Risk





Conclusion

HPC Trends

- Increased Engineering Productivity
- Increased Product Complexity
- Increased Product Integrity
- Emerging Cloud Adoption
- Heterogeneous HPC environment
- Increased demand for GPU computing



Conclusion

- Ansys implementation of Slurm
- HPC at Ansys is advancing
- Increased Engineering Productivity, Product Complexity, and Product Integrity



Come see us at www.ansys.com and at SC24

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HPC Solutions

Understand how scalable high-performance computing (HPC) solutions enable you to perform more high-fidelity simulations in less time on today's multicore computers.

[FREE TRIAL](#)

BIGGER, BETTER, FASTER SIMULATION

Enhanced Insight and Engineering Productivity Enabled by HPC

With the Ansys HPC software suite, you can use today's multicore computers to perform more simulations in less time. These simulations can be bigger, more complex and more accurate than ever using high-performance computing (HPC). The various Ansys HPC licensing options let you scale to whatever computational level of simulation you require, from single-user or small user group options for entry-level parallel processing up to virtually unlimited parallel capacity.

For large user groups, Ansys facilitates highly scalable, multiple parallel processing simulations for the most challenging projects when needed. Apart from parallel computing, Ansys also offers solutions for parametric computing, which enables you to more fully explore the design parameters (size, weight, shape, materials, mechanical properties, etc.) of your product early in the development process.

[ANSYS HPC BROCHURE](#)

Quick Specs

Enabling parallel and parametric processing	Single solution for fluids, structures and electronics
Scalable, value-based licensing	Enabling CPU and GPU based computing

Overview Capabilities Licensing Resources & Events

HPC Capabilities

Check out the below benchmarking and computing capabilities to convince yourself about the benefits of high-performance computing (HPC) for engineering simulation.

Benchmarking Capabilities

- ROI** Workstation Refresh ROI Estimator
Get time savings and ROI based on standard benchmarks.
- Monitor** Benchmark Your Workstation for Your Own Model
Once you see the time that can be saved for your own simulation model, you may be convinced to migrate from your desktop computer to an HPC cluster solution.
- Ansys Cloud** Run Your Own Benchmarks on Ansys Cloud
Go for a one-month free trial on the cloud and experience HPC as easy it should be.
- PERFORMANCE** Standard Benchmarks
Check out the overview and performance.

Computing Capabilities

- On-premises Hardware Solutions**
Hardware configurations recommended by HPC partners can provide you with the best return your hardware and Ansys software investment for on-premises deployments.
- Ansys Cloud Solution**
Replicate your setup and instant access to on-demand HPC resources in the cloud.

Overview Capabilities Licensing Resources & Events

HPC RESOURCES & EVENTS

Featured Webinars

- IT Webinar Series**
This webcast series shares the knowledge and experience of Ansys experts, to support strategic decision making related to IT systems for Ansys technology.
- Ansys Cloud Webinar Series**
This webinar series is designed for IT Professionals and touches on all relevant aspects of running Ansys in a cloud partner computing environment.

White Papers

- The Value of High-Performance Computing for Simulation**
Learn how software licensing and pricing models can ensure the highest value for engineering simulation workloads.
- Study on HPC Usage for Engineering Simulation**
- Study on Cloud Computing Engineering Simulation**
- Research Report - All You Need to Know about Hardware for Simulation**
- Manufacturing Speed and Agility Enabled by Turnkey HPC Solutions**

Blogs

- More Fast Processor Options for Engineering Simulation**
- Survey Shows Emerging Cloud Computing Capabilities and the COVID-19 Effect**
- Simulation User Survey Results: Evolving Workflows Affect HPC Usage**
- Accelerating Automotive CFD Simulations with HPC**
- Hardware Tips to Accelerate Simulation**

The Ansys logo consists of a yellow slanted bar followed by the word "Ansys" in a bold, black, sans-serif font.

