

Simplifying HPC

For engineering simulation with Ansys



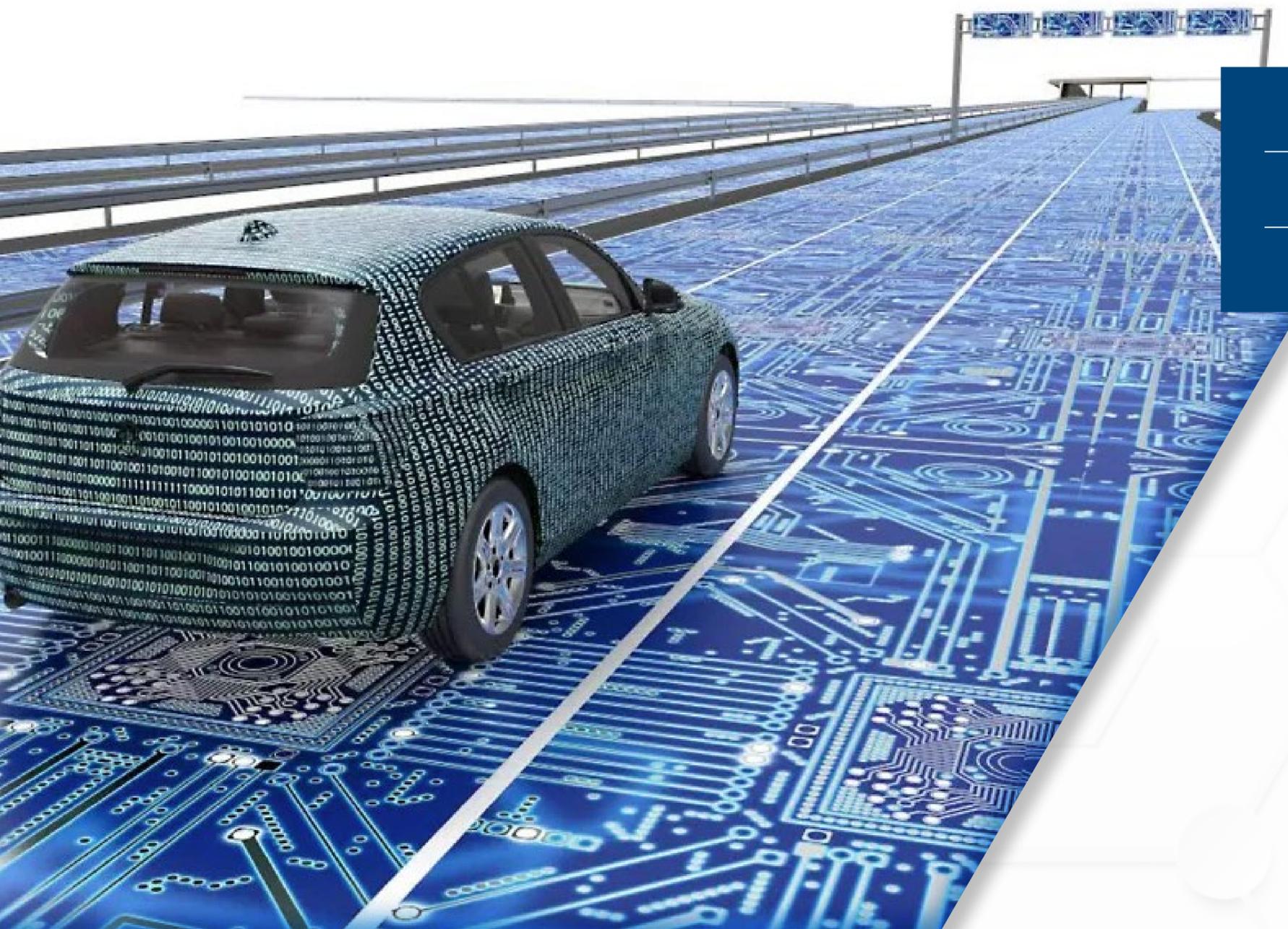


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Accelerating computer-aided engineering with Dell Validated Designs for Ansys

Tap into the power of HPC to speed engineering and design workloads

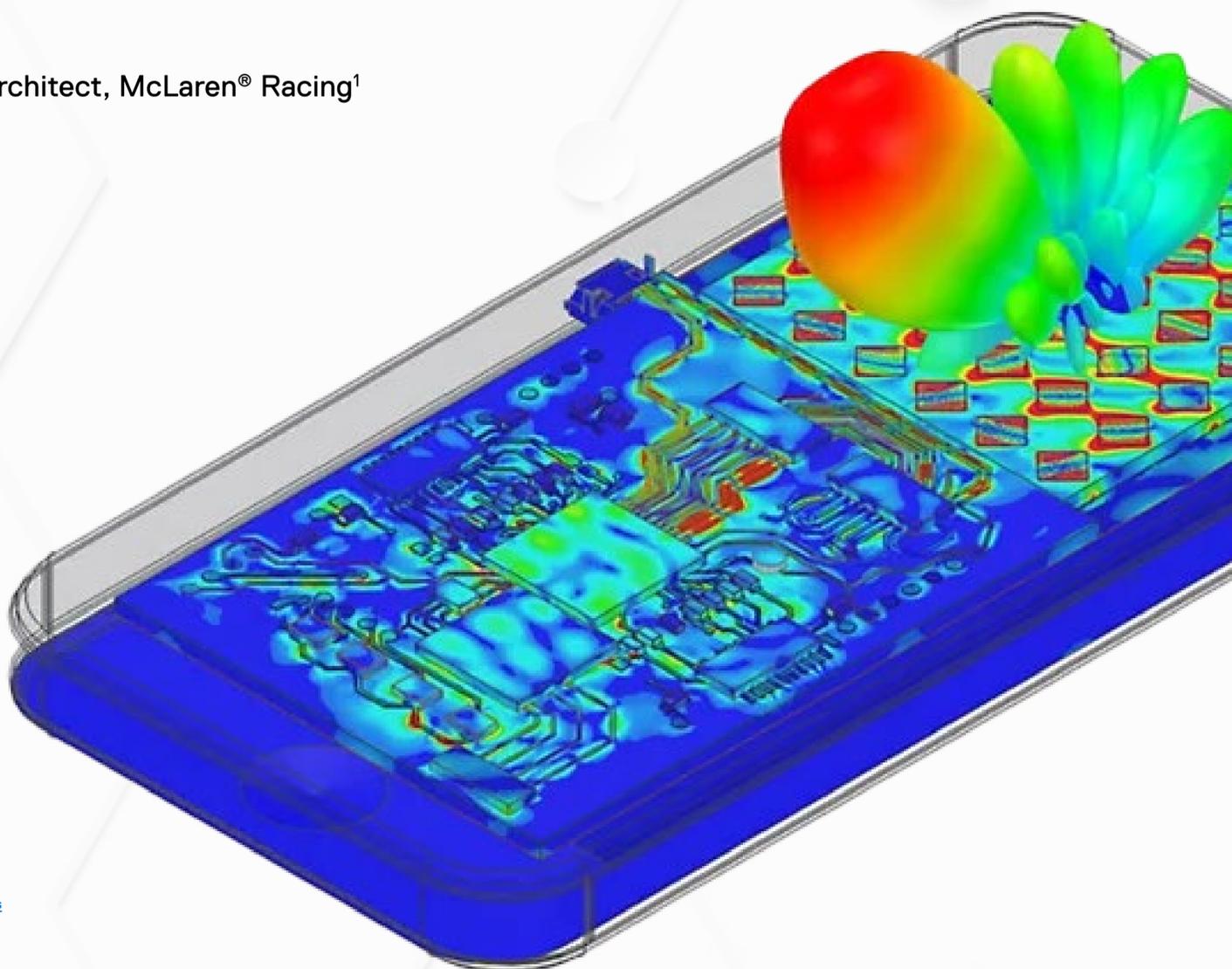
For decades, manufacturing engineers have been using computer-aided engineering (CAE) programs, such as Ansys® software, to help speed time to market with more innovative and higher-quality products.

As the technology advances, these workloads become incredibly data-intensive, especially as teams increasingly spread across the globe. To answer the challenge of providing adequate IT resources to distributed teams, many manufacturers are growing from workstations into high performance computing (HPC) clusters.

To help engineering teams adopt HPC more easily, Dell Technologies created Validated Designs for HPC Digital Manufacturing with Ansys. These solutions are Dell engineering-tested, -validated and -optimized specifically for CAE, so your team can continue to innovate at speed and scale.

“We can perform our aerodynamics studies using computational fluid dynamics faster with our new Dell Technologies HPC system compared to our previous setup.”

Edward Green,
Principal Digital Architect, McLaren® Racing¹



¹ Dell Technologies infographic, [In today's race, milliseconds count](#), April 2021.

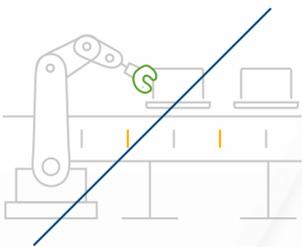
HPC for engineering

Challenges



Workstations alone can't keep up.

The team needs more compute and storage than their individual workstations can deliver.



We need to deploy solutions more quickly and easily.

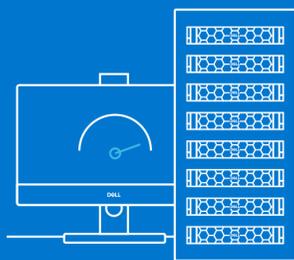
To keep up with advancements in digital manufacturing software capabilities, you need the power to scale quickly and easily.



It's important to reduce risks for HPC investments.

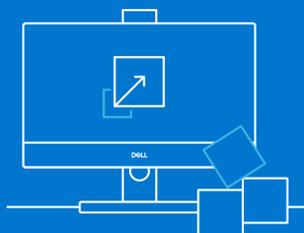
HPC is an important source of competitive advantage, but designing and deploying complex HPC systems in-house introduces the chance for errors.

Dell Technologies solutions



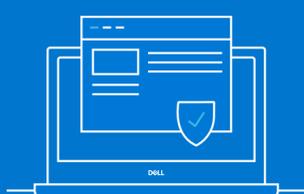
Faster performance

Dell Technologies makes it easy to customize an HPC solution that delivers the throughput and capacity needed to manage rapid data growth and increased workload demands.



Easier deployment and scaling

Dell Validated Designs for Ansys are built with modular building blocks that enable you to scale easily to meet new capacity and performance demands.



Reduced risk

Validated Designs reduce deployment risks and increase system reliability. With proven success in thousands of implementations worldwide, you can rely on Dell Technologies.



HPC



The Dell Technologies difference

Expertise and guidance

The technology for engineering is evolving quickly, so your team may not have time to develop the skills required to design, deploy and manage HPC solutions optimized for Ansys. Dell Technologies has been a leader in the advanced computing space for more than a decade, with proven products, solutions and expertise. Dell Technologies has a team of HPC and AI experts dedicated to staying on the cutting edge, testing new technologies and tuning solutions to your applications to help you keep pace with this constantly evolving IT landscape.

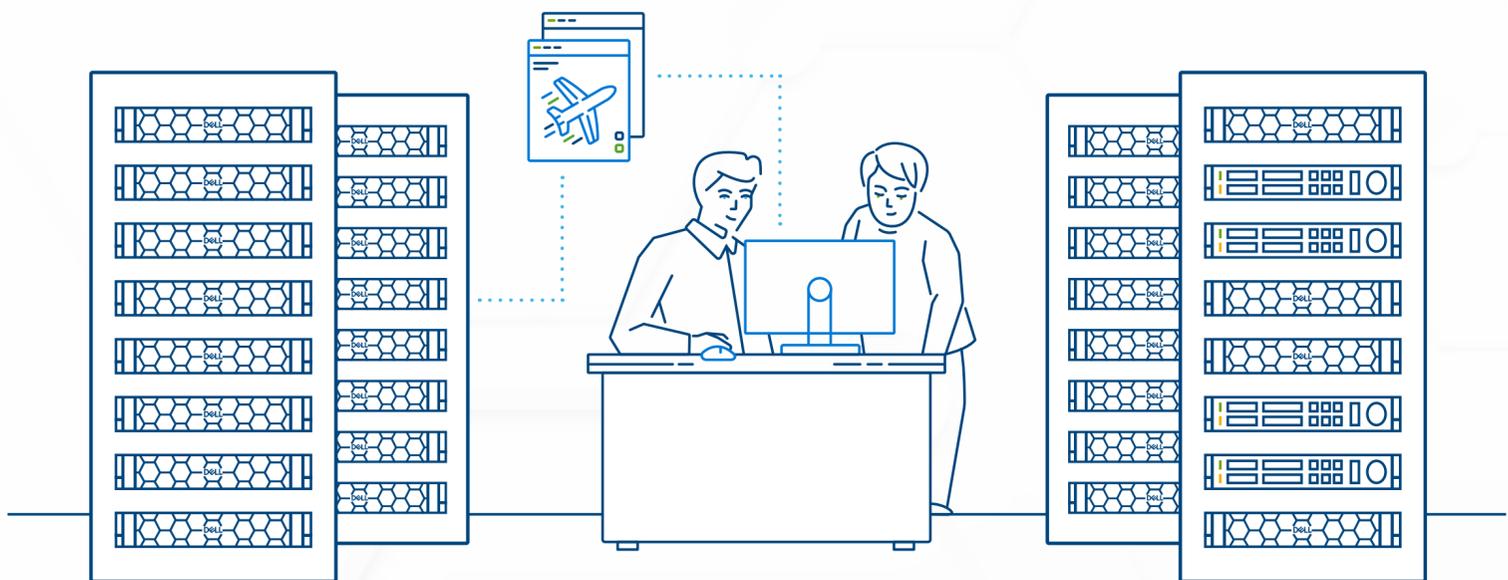
Dell Validated Designs for Ansys

For many engineers, HPC is — or is becoming — an important source of competitive advantage. An optimized HPC solution delivers the compute, throughput and capacity needed to manage the rapid data growth and increased workload demands presented by Ansys and other workloads. Validated Designs are workload-optimized systems with servers, software, networking, storage and services to scale faster with the confidence of an engineering-tested solution while enabling business without boundaries.

Solutions customized for your environment

Dell Technologies uniquely provides an extensive portfolio of technologies to deliver the advanced computing solutions. With years of experience, and an ecosystem of curated technology and service partners, Dell Technologies provides innovative solutions, workstations, servers, networking, storage and services that reduce complexity and enable you to capitalize on HPC for Ansys workloads.

Collaborating to simplify HPC



Customer Solution Centers

Our global network of dedicated Dell Technologies [Customer Solution Centers](#) are trusted environments where you can freely test and validate solutions and products. Customize proofs of concept, brainstorm with experts, and deep dive into technologies to explore what's possible both now and into the future.

HPC & AI Innovation Lab

The Dell Technologies [HPC & AI Innovation Lab](#) in Austin, Texas, is the flagship innovation center. Housed in a 13,000 square-foot data center, it gives you access to thousands of Dell servers, three powerful HPC clusters — including the AMD®-powered Minerva — and sophisticated storage and network systems. It's staffed by a dedicated group of computer scientists, engineers and Ph.D. subject matter experts who actively partner and collaborate with customers and other members of the HPC community. The team engineers HPC and AI solutions, tests new and emerging technologies, and shares expertise including performance results and best practices.

HPC & AI Centers of Excellence

As analytics, HPC and AI converge and the technology evolves, Dell Technologies worldwide [HPC & AI Centers of Excellence](#) provide thought leadership, test new technologies and share best practices. They maintain local industry partnerships and have direct access to Dell Technologies product planners and other technology creators to incorporate your feedback and needs into their roadmaps. Through collaboration, Dell Technologies HPC & AI Centers of Excellence provide a network of resources based on the wide-ranging know-how and experience in the community.

Consume HPC as-a-Service with Dell APEX

With simple and consistent cloud experiences delivered as-a-Service (aaS), [APEX](#) can help you optimize your HPC capabilities with a company invested in your future. APEX helps you dive right into discovery by spending less time on infrastructure, while our robust portfolio of products and services maximize HPC performance, efficiency and flexibility. Find out how the know-how, innovation and support of Dell Technologies APEX can help you fast-track HPC projects.

Speed success with services

[Dell Technologies Services for HPC](#) include consulting, deployment, support and education to help drive the rapid adoption and optimization of HPC environments from initial setup and upskilling of resources through to ongoing support. [Managed Services](#) and [Residency Services](#) can help reduce the cost, complexity and risk of managing IT so you can focus resources on digital innovation and transformation.

“The simulation race and the innovation race that sits just behind that is underpinned by great technology. We’re never more than a meter or a millisecond away from a piece of Dell Technologies equipment.”

Jonathan Neale,
Chief Operating Officer, McLaren Group²



² Dell Technologies case study, [McLaren](#), accessed June 2022.

Single-server solution

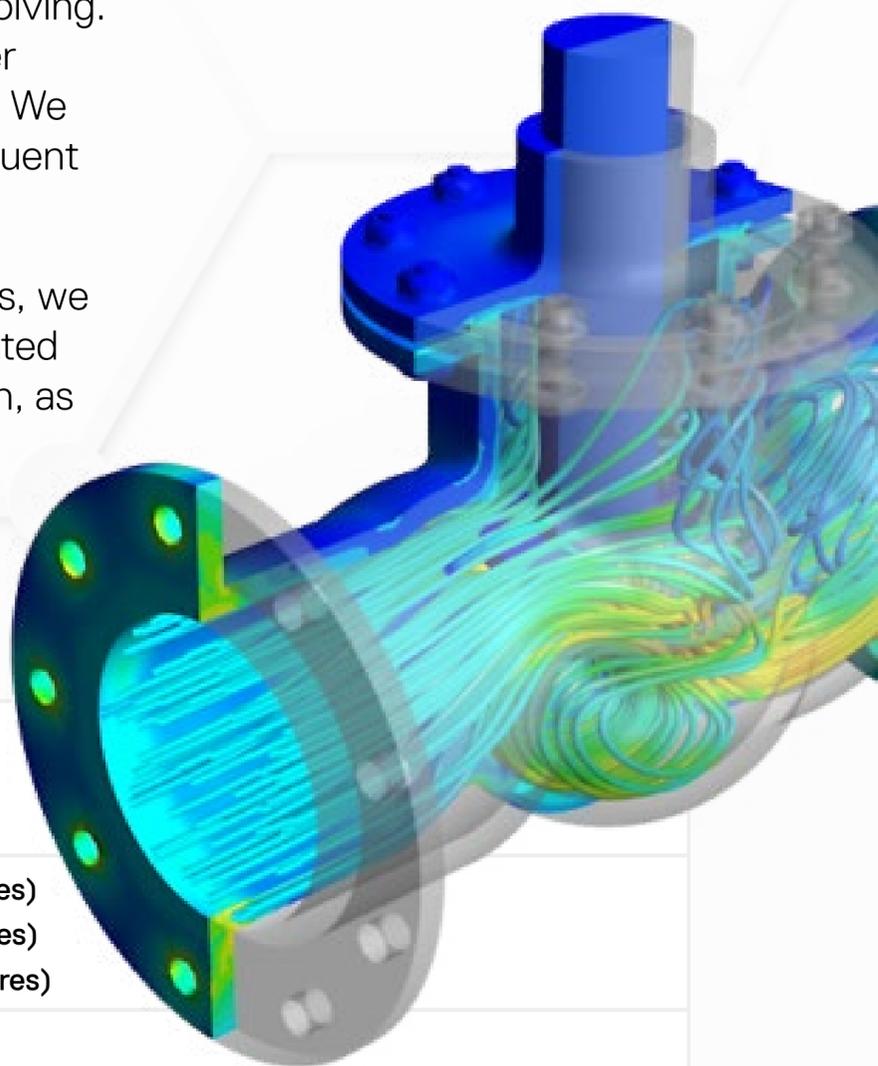
Many engineering teams can be deterred from deploying HPC by the complexity and cost of acquiring, deploying and managing an HPC cluster. Dell Technologies uses extensive knowledge and experience in supercomputing to provide solutions for Ansys that answer the computational needs of workgroups and departments.

Ansys Fluent® is a computational fluid dynamics (CFD) software application commonly used for a wide range of CFD and multiphysics simulations. CFD applications typically scale well across multiple processor cores and servers, have modest memory capacity requirements, and typically perform minimal disk I/O while solving. However, some simulations might have greater I/O demands, such as large transient analysis. We evaluated 15 benchmark problems from the Fluent benchmark suite on three reference systems.

To simplify comparison of the available designs, we show top-line benchmarks, engineering-validated configurations and component details for each, as detailed below and on the following pages.



We evaluated 15 benchmark problems from the Fluent benchmark suite on three reference systems.



| | |
|---------------------------------------|--|
| Dell PowerEdge compute server options | 1x C6525 1x R6525 1x R7525 |
| AMD EPYC™ processor options | 2x 7532 (2.4Ghz, 32-cores) 2x 7543 (2.8Ghz, 32-cores) 2x 7573x (2.8Ghz, 32-cores) |
| Cores | 64x cores per node |
| Switches | 1x Dell PowerSwitch N3248TE-ON (management) 1x NVIDIA® QM8790 40-port HDR InfiniBand® |
| Dell PowerEdge infrastructure server | 1x R6515 (2x R6515 for high availability) |
| AMD EPYC processor | 1x 7402P |
| Dell storage options | PowerScale A300 PowerScale F600 Validated Designs for BeeGFS HPC Storage |
| Software | Ansys Fluent Bright Cluster Manager® |

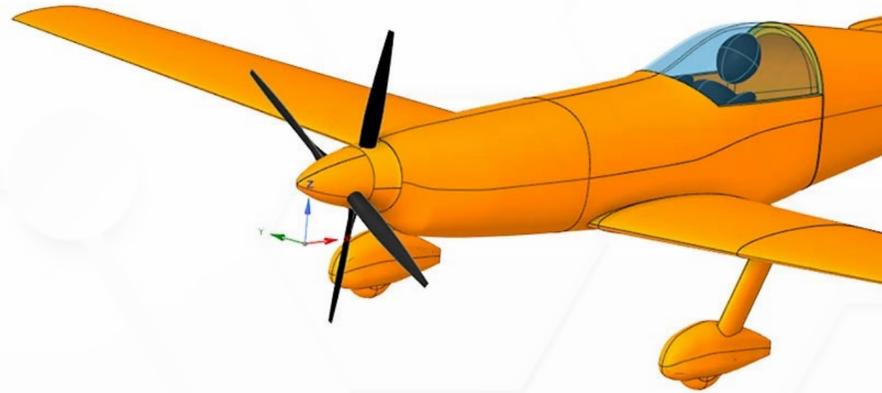
Ansys performance benchmarks

Ansys engineering simulation workloads

Fluid simulations

This entry-level 1-node / 64-core system is capable of running several simultaneous Ansys Fluent simulation models in the size range of 2–71 million cells, fully utilizing the up to 512GB of system memory per compute node.

For a description of the benchmark cases, see the [Ansys Benchmarks Overview](#).

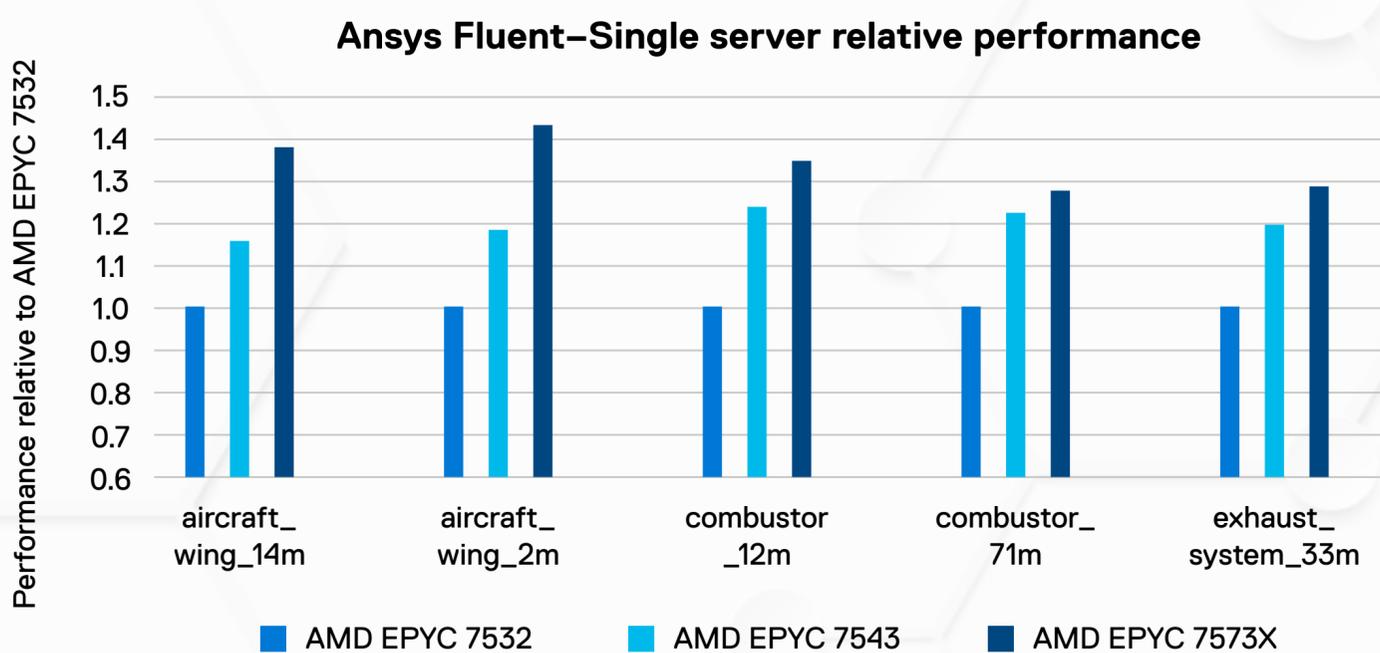


Performance

As an example of how the pre-configured solutions perform with real-world applications, we include benchmark results for the following well-known Ansys Fluent benchmarks:

- **Aircraft_14m** (External flow over an aircraft wing, hexahedral mesh)
- **Aircraft_2m** (External flow over an aircraft wing, hexahedral mesh)
- **Combustor_12m** (Flow through a combustor with polyhedral mesh)
- **Combustor_71m** (Flow through a combustor with hex-core mesh)
- **Exhaust_system_33m** (External flow over a truck body with mixed cells)

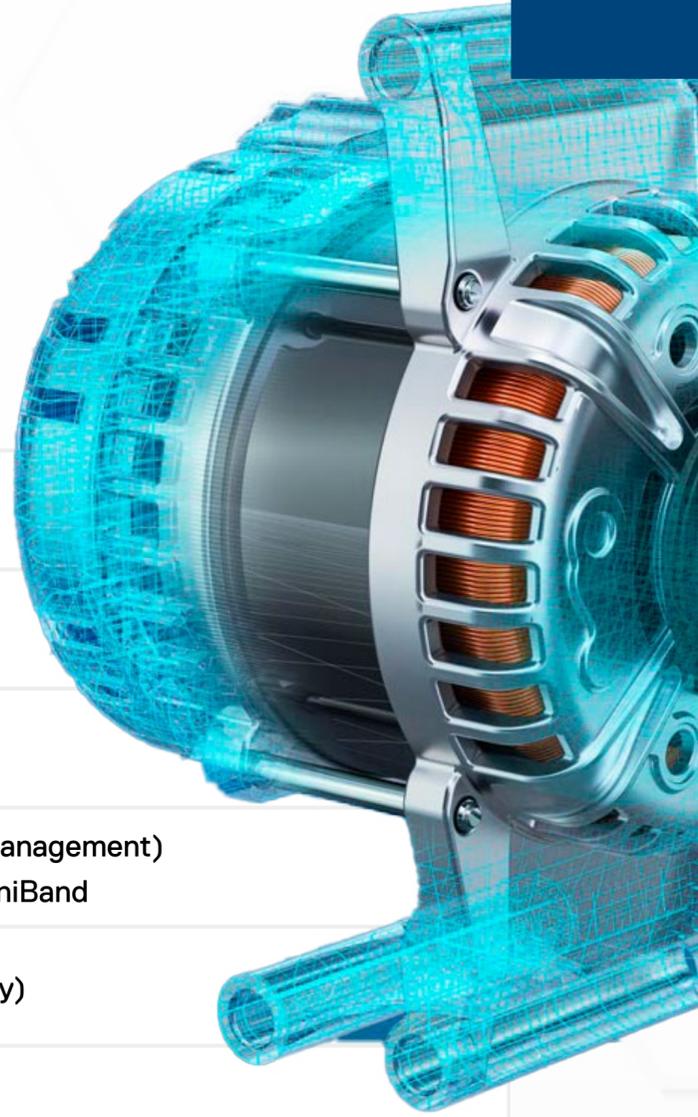
The following figure shows measured performance for the Ansys Fluent benchmarks using Ansys Fluent 2022 R1 on a single server:



The results are plotted relative to the performance of a single Dell PowerEdge C6525 server configured with AMD EPYC 7532 processors. Larger results indicate better performance. These results show the performance advantage available with AMD EPYC 7003 series processors, the EPYC 7543 and the EPYC 7573X.

Multi-server solution

Engineers running a wide range of parallel applications that require more compute power may benefit from a multi-server solution. The following benchmarks were performed on 1-, 2-, 3- and 4-node clusters to show how the solution scales as more nodes are added.



| | |
|---------------------------------------|---|
| Dell PowerEdge compute server options | 1, 2, 3 or 4x C6525 |
| AMD EPYC™ processor options | 2x 7573X per node |
| Cores | 64x cores per node |
| Networking | 1x Dell PowerSwitch N3248TE-ON (management) 1x NVIDIA® QM8790 40-port HDR InfiniBand |
| Dell PowerEdge infrastructure server | 1x R6515 (2x R6515 for high availability) |
| AMD EPYC processor | 1x 7402P |
| Dell storage options | PowerScale A300 PowerScale F600 Validated Designs for HPC BeeGFS Storage |
| Software | Ansys Fluent Bright Cluster Manager |

Ansys performance benchmarks

Ansys engineering simulation workloads

Fluid simulations

The 4-node 256-core system is capable of running 14 or more simultaneous Ansys Fluent simulation models in the size range of 2–140 million cells, fully utilizing up to 512GB of system memory per compute node.

For a description of the benchmark cases, see the [Ansys Benchmarks Overview](#).

Performance

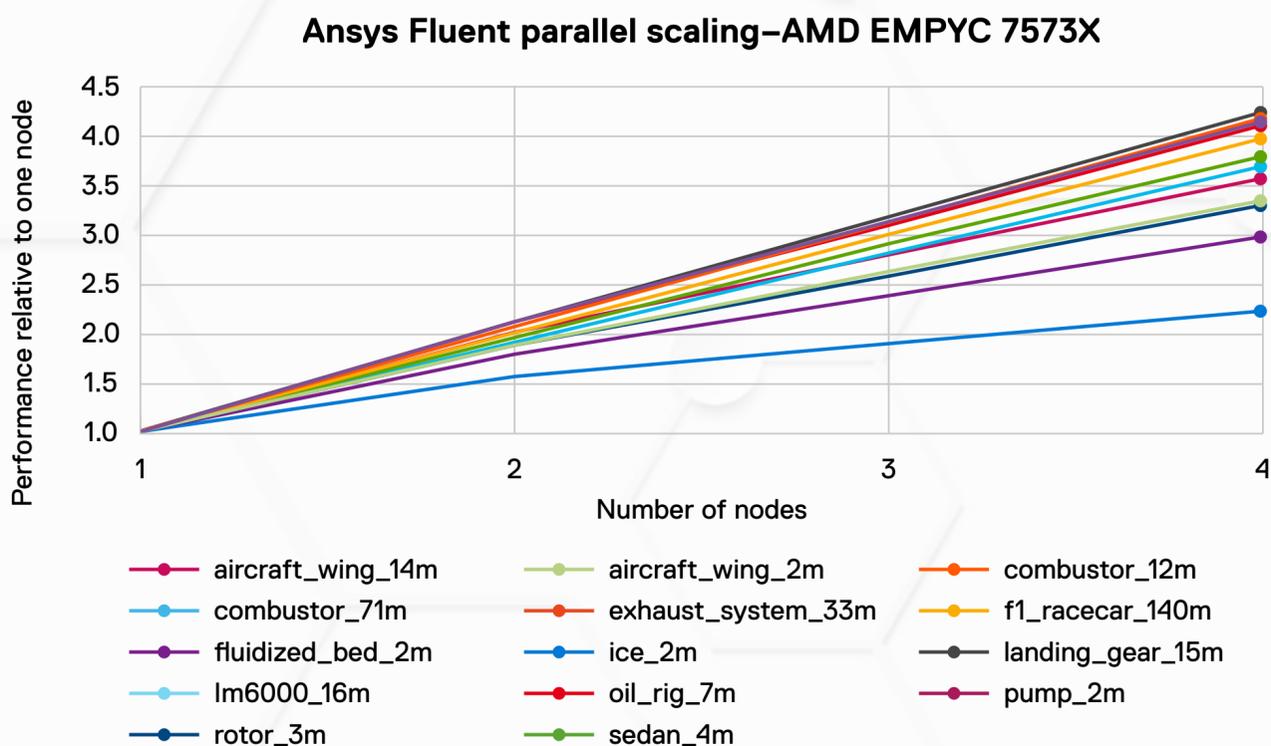
As an example of how the Validated Design performs with real-world applications, we performed the following well-known Ansys Fluent benchmarks:

- **Aircraft_wing_14m** (External flow over an aircraft wing, hexahedral mesh)
- **Aircraft_wing_2m** (External flow over an aircraft wing, hexahedral mesh)
- **Combustor_12m** (Flow through a combustor with polyhedral mesh)
- **Combustor_71m** (Flow through a combustor with hex-core mesh)
- **Exhaust_system_33m** (External flow over a truck body with mixed cells)
- **F1_racecar_140m** (External flow over a Formula-1 racecar with hex-core mesh)
- **Fluidized_bed_2m** (Circulating fluidized bed with mixed cells)
- **Ice_2m** (4-stroke spray guided gasoline direct injection model with mixed cells)
- **Landing_gear_15m** (Boeing landing gear analysis with mixed cells)
- **Lm6000_16m** (flow through combustor with hexahedral mesh)
- **Oil_rig_7m** (wave loading on oil rig with mixed cells)
- **Pump_2m** (cavity flow in a centrifugal pump with hexahedral mesh)
- **Rotor_3m** (Transonic axial flow in a rotor with hexahedral mesh)
- **Sedan_4m** (External flow over passenger sedan with mixed cells)

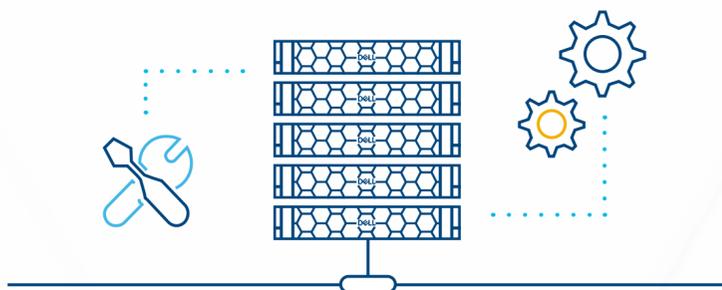
The following figure shows the parallel scalability of the Fluent benchmark models using up to four servers configured with AMD EPYC 7573X processors. The performance is presented relative to the performance of a single server.

The results show that the performance scales almost linearly with the addition of each node, as expected. This is achieved due to the efficient implementation of software from Ansys on the distributed computational resources.

The ice_2m benchmark does not scale as well as the other benchmarks. This result is expected as it is a small model that includes dynamic mesh and combustion simulation.



Validated configuration options



Dell PowerEdge servers

PowerEdge servers are engineered to deliver unmatched performance and versatile configurations to meet the demands of HPC workloads. Flash storage, the latest processors, and memory with flexible local storage make PowerEdge servers a foundational choice.

- PowerEdge C6525 is a compute-dense server designed to boost data center performance to tackle a variety of HPC workloads and applications like CAE.
- PowerEdge R6525 is ideal for dense environments, delivering performance and innovation in a dual-socket, 1U server that can handle workloads like HPC and VDI.
- PowerEdge R7525 is a highly scalable two-socket 2U rack server that delivers powerful performance and flexible configurations.
- PowerEdge R6515 is a single-socket server that is well-suited for the infrastructure or management server and ideal for easily scaling the environment.

AMD EPYC 7003 processors

With high frequencies, high core counts, high memory bandwidth and capacity, and up to 256MB of L3 cache, AMD EPYC 7003 processors enable exceptional HPC performance, making them the new standard for the modern data center. Collaboration between AMD and Ansys offers high performance and scalability for CFD workloads.

Dell PowerScale storage

Designed to reduce complexity and optimize results for data-intensive digital manufacturing workloads, PowerScale gives you scalable, available storage that eases adoption and management. PowerScale is available in hybrid and all-flash models to quickly deliver large amounts of data to simulation models for faster, more accurate results.

PowerScale A300 provides raw storage capacity of 120TB to 75PB and sufficient performance for modest-sized HPC systems. For larger HPC systems, the **PowerScale F600 all-flash NAS**, with raw storage capacity of 15.36TB to 122.8TB, provides a significant performance benefit compared to the PowerScale A300.

Dell Validated Designs for HPC BeeGFS Storage

For HPC systems requiring a high-performance parallel file system, the Validated Design for BeeGFS Storage in the high-performance configuration is recommended. This solution provides 25.6TB of raw storage capacity per storage server and can be expanded to any required storage capacity.

Dell PowerSwitch networking

Based on open standards, PowerSwitch networking frees the data center from outdated, proprietary approaches. Our future-ready networking technology helps you improve network performance, lower networking costs and remain flexible to adopt new innovations.

Ansys, Dell Technologies and AMD

Ansys applications like Fluent see outstanding performance on Dell PowerEdge servers with AMD EPYC processors and AMD Instinct™ GPUs. The close relationship between Dell Technologies, Ansys and AMD aligns engineering efforts to optimize performance of Ansys applications. This results in the timely qualification and certification of new hardware and drivers that provide an optimal user experience with Ansys.

Ansys applications like Fluent see outstanding performance on AMD-powered Dell hardware, from workstations to HPC systems to the cloud

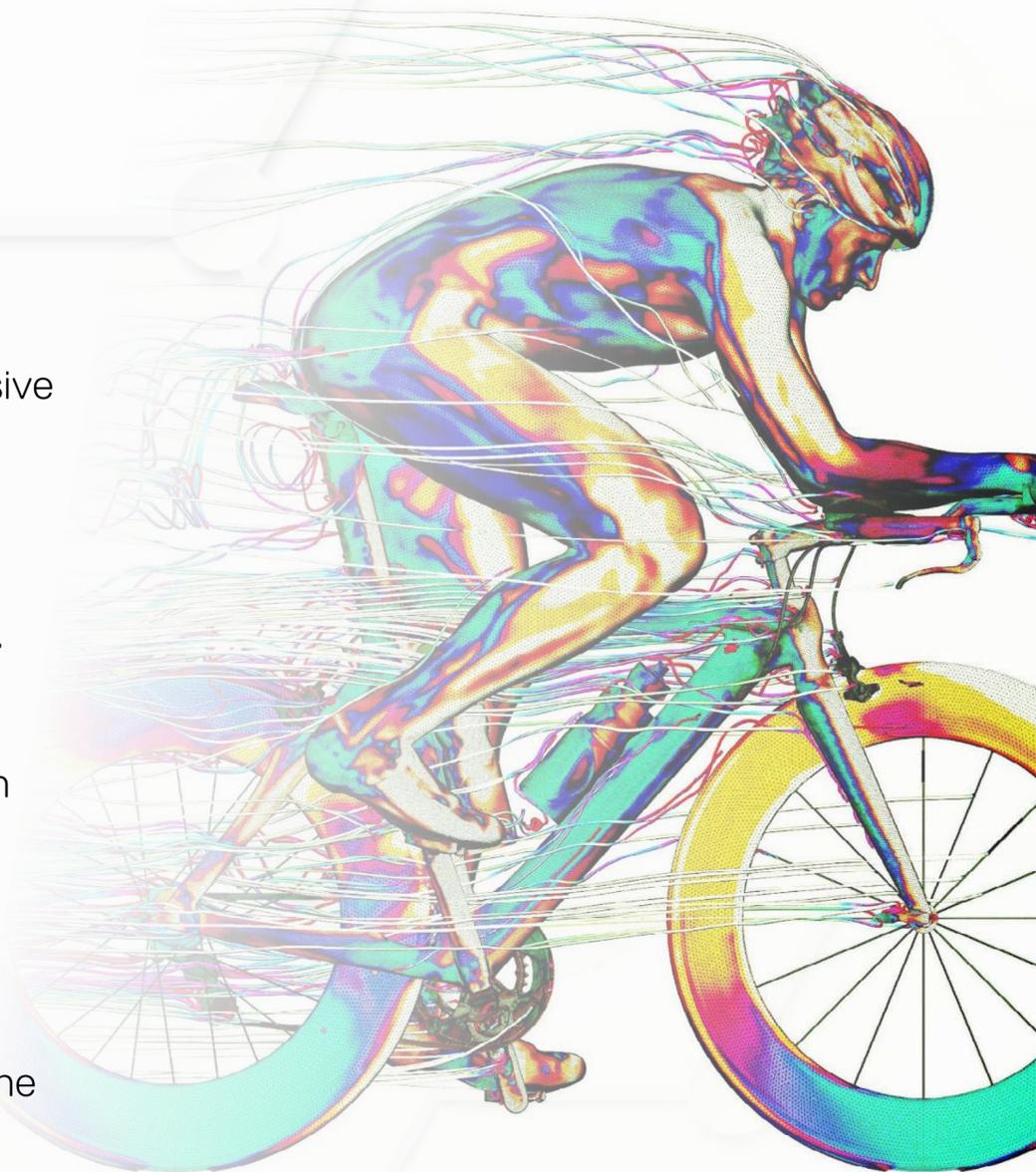
Proven results

Dell Validated Designs for Ansys are architected to provide a comprehensive HPC solution for CAE software.

The building block approach allows manufacturing engineers to easily deploy an HPC system optimized for specific workload requirements.

The design addresses computation, storage, networking and software requirements, and provides a solution that is easy to install, configure and manage, with installation services and support readily available.

The performance benchmarking substantiates the solution design, demonstrating the performance of the solution with Ansys Fluent software.



Learn more

dell.com/hpc

Solution partner 

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