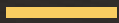


ORACLE



High-Performance Computing on Oracle Cloud Infrastructure (OCI)

The Challenge

Until recently, [High-performance computing](#) (HPC) has been more frequently run on-premises in customer managed datacenters. But this presented many limitations including large upfront capital costs and long deployment times for computing equipment, constant expenditures for ongoing management and operational costs, queueing delays when demand surges, and unused equipment when demand falls. Further, long gaps between hardware upgrades remain challenging while newer processors become available in the market. The HPC on-premises model fails to meet the needs of all HPC users as workload requirements rapidly diversify – CPU or GPU? Intel or AMD? Server, container, or serverless? Meanwhile the pace of discovery and innovation is relentless and requires a more flexible computing platform – such as cloud or hybrid HPC.

Our Solution

Oracle [Cloud HPC solutions](#) combine the performance of on-premises solutions with the elasticity and consumption-based costs of the cloud, giving customers the option to migrate away from, or supplement, capital intensive on-premises systems. The Oracle Cloud Infrastructure HPC solution includes bare metal compute instances, ultra-low latency RDMA, high-performance storage solutions and file systems, network traffic isolation, and the tools you need to automate and run jobs seamlessly in the cloud. For everything from crash simulations in the automotive industry to seismic analysis for oil and gas companies to special effects rendering for media companies, Oracle's cloud-based infrastructure is enabling customers to solve complex technical problems—faster. With OCI, you can:

- ✓ Achieve [superior price performance over other cloud providers](#) with 44% lower costs for HPC
- ✓ Leverage high bandwidth, ultra-low latency RDMA network with latency less than 2 microseconds
- ✓ Choose from an array of parallel file systems like IBM Spectrum scale, BeeGFS, Lustre, and more
- ✓ Easily scale HPC applications across numerous nodes just as well as they would in your data center
- ✓ Only pay for the [resources you use](#)
- ✓ Protect yourself with [industry-first, comprehensive SLAs](#) for availability, performance, and manageability

TOYOTA

Toyota moves high-performance workloads to Oracle Cloud

World's largest automaker shifts high-performance computing workloads to Oracle Cloud Infrastructure to improve car design and development efficiency

"We now run our HPC workloads on Oracle Cloud Infrastructure as part of our HPC multicloud strategy. OCI has incredible performance, and running computational fluid dynamics simulations with it has allowed us to improve the speed of computations and to optimize costs. This is helping us make the development of cars at Toyota more efficient, and produce cars with better performance."

Shinichi Noda
Group Leader, DX Promotion Division,
Toyota Motor

NISSAN MOTOR CORPORATION

Nissan Moves to Oracle Cloud Infrastructure for High-Performance Computing

Nissan accelerates design and testing of new cars by moving on-premises, high-performance computing (HPC) workloads to OCI

"We selected Oracle Cloud Infrastructure's HPC solutions as a part of our multi-cloud strategy to meet the challenges of increased simulation demand under constant cost savings pressure. I believe Oracle will bring significant ROI to Nissan."

Bing Xu
General Manager, Engineering Systems Department
Nissan Motor Co, Ltd



DENSO

Crafting the Core

Denso Techno reduces vehicle noise analysis time by 5X on Oracle Cloud

Denso Techno, one of the world's largest automotive parts manufacturers, cuts complex fluid noise analysis and simulation times with high-performance compute (HPC) on OCI.



Realized immediate price-performance improvement versus old on-premises environment



Calculations now run 5X faster than the previous solution, reducing calculation time from 15 days to 3 days, and cutting costs by nearly 50%



Plan to use Oracle Cloud HPC to establish basic technology for noise analysis and further improve the level of simulation utility in its designs

“Now that we have various technical support from Oracle, including networking, we can prepare a cloud environment in a short period of time. We look forward to strong support from Oracle, including providing the latest advanced technologies in the future.”

Keiji Koumura

Computer-Aided Engineering Department,
Denso Techno

OCI HPC Advantage

Lowest Cost HPC in the Cloud

Oracle offers the lowest cost per core-hour among cloud providers for high-performance computing. In independent testing, OCI delivers 44% lower costs than other cloud vendors for HPC along with guaranteed performance. Oracle often outperforms on the cost-per-job thanks to our industry-leading performance with bare-metal nodes and low-latency networking. Competitors like AWS don't offer this architecture, and their closest solution, the C5n, is significantly more expensive.

Bare-Metal Performance

Compared to virtual machines, Oracle's bare-metal compute instances yield faster and more-consistent results that are comparable to an on-premises compute infrastructure. High core frequencies and cluster networking give Oracle's bare-metal compute instances significant performance improvements over other public clouds and onsite data centers. Each bare-metal HPC instance has 36 cores from two 3.6 GHz Intel® Xeon® Gold 6354 processors, formerly code-named "Ice Lake", 512 GB RAM, and 3.8 TB NVME local storage.

Scalability

Being able to scale out your HPC jobs to thousands of cores means shorter turnaround times and faster time-to-market. (Or time-to-discovery for our friends in research.). Tightly-coupled HPC applications can't scale efficiently or at all on commodity networking but require dedicated HPC interconnects. OCI provides an extremely fast RoCE (RDMA over Converged Ethernet) network with the lowest network latency in the cloud - as low as 1.5 mus. We've benchmarked a wide variety of applications, from CFD to weather forecasting, and our scaling graphs match current on-premises systems. Many customers find they can dramatically cut turnaround times by moving their HPC workloads to OCI and scaling out.

Access to the Latest Industry Technologies

With Oracle Cloud Infrastructure, customers have access to the latest generation of industry-leading technologies. Oracle offers the newest processors including Intel's 3rd gen Ice Lake Xeon, 3rd gen AMD Milan, Ampere Arm Altra and Nvidia A100 GPUs to give organizations the best performance while taking on the most intensive workloads.



HPC Features on OCI

HPC Network Interconnects

Oracle's dedicated HPC back-end network fabric uses Mellanox's ConnectX-5, 100 Gbps network interface cards to provide RDMA over converged Ethernet (RoCE) v2, creating clusters with the same low-latency networking (<2µs) and application scalability you expect from your on-premises clusters.

Autoscaling HPC Clusters

With OCI, customers can easily expand their HPC cluster as needed using compute autoscaling while also keeping costs under control by stopping compute instances not being used. The automatic starting and stopping of compute instances provides consistent performance when demand is high and reduces costs when demand is low. Lastly, OCI eliminates the need to keep jobs waiting in the queue, or to waste money on idle compute nodes.

GPUs on Bare Metal and Virtual Machines

Oracle Cloud has high performance virtual machines, bare metal servers, and NVIDIA [GPU options](#) for graphics-intensive workloads. Applications that rely on AI and ML workloads benefit from running GPUs as they allow companies to solve complex problems and innovate faster. Because AI workloads need fast and large volumes of storage and computing power, companies like [HEARTio](#), run HPC on OCI and can develop AI technologies that will undoubtedly change lives.

HPC Storage

Oracle offers storage options for all the needs of high-performance computing users. These options are:

- **Local NVMe SSD:** High-speed local flash storage ideal for high-performance computing and big data workloads
- **Block volumes:** Networked block storage services offering up to 1000 IOPS per GB, up to 35,000 IOPS per volume
- **Parallel file systems:** Traditional storage can't provide enough throughput for performance-intensive workloads that process large volumes of data quickly. To meet these needs, Oracle makes it easy to deploy GlusterFS, BeeGFS, Lustre, and IBM Spectrum Scale high-performance file systems that can deliver up to 500 GBps aggregate throughput to HPC clusters.
- **The fastest file servers in the cloud:** Oracle and IBM have partnered to provide [high-performance file servers](#) at scale on OCI. Using IBM Spectrum Scale, you can now build a high-performance computing file server on OCI Block Storage for your HPC or big data applications.



Altair tests and runs complex simulations overnight on OCI

The company flipped its cutting-edge design applications into overdrive by developing and running them on high-performance Oracle Cloud Infrastructure.



Cut on-premises setup time for new HPC environments from 8 to 12 weeks to less than an hour on OCI



OCI's low latency RDMA networking services deliver up to 20% better price-performance for CFD



Made its most advanced engineering suite, HyperWorks CFD Unlimited, available on OCI

“The integration with Oracle's cloud platform provides us with state-of-the-art GPU compute resources, world-class security, and highly flexible VMware environments. Ultimately, this leads to improved productivity, optimized resource utilization, and faster time to market.”

Sam Mahalingam

CTO for Enterprise Solutions, Altair

nationalgrid

“Oracle Cloud Infrastructure allows us to process tens of thousands of models, so we can train our algorithms very quickly. It’s one of the best platforms in the world for the type of work we do.”

James Kelloway, Energy Intelligence Manager
National Grid ESO



“The main benefit our customers see using Oracle Cloud Infrastructure is the ability to accelerate their workloads, through fast deployment and orchestration at scale. In many cases jobs run more quickly than customers ever imagined possible.”

Simon Ponsford, CTO
YellowDog
[Read the YellowDog Story](#)



“We tried other clouds before discovering Oracle Cloud Infrastructure, but for our specific applications and use cases, OCI proved to be the best enterprise-grade solution. The scalability, flexibility, and security were key to our success.”

Pietro Lascari, Delivery Manager
ALEF
[Read the ALEF Story](#)

HPC Industry Solutions

Oracle designed its HPC cloud platform to meet the needs of enterprise-class customers with the most demanding workloads. High-performance computing is a business-critical workload and is the fastest growing segment in the cloud. Many industries use HPC technology in their day-to-day business but have different needs and architectures from one another. Oracle makes it possible for diverse industries to all succeed using HPC on OCI:

Manufacturing

Computational Fluid Dynamics (CFD) simulates the motion of air and fluid to improve product engineering. In the automotive sector, manufacturers simulate cabin airflow, engine oil dynamics, and the air flow around the car to improve fuel efficiency. As a tightly coupled MPI-based workload, CFD benefits from Oracle’s RDMA cluster networking, high-frequency Intel processor-based compute instances, and the latest NVIDIA GPUs.

[Nissan Moves to OCI](#)

Healthcare & Life Sciences

Molecular and biological simulations support experiments in life sciences and healthcare. The variety of HPC instances on OCI help workloads such as DNA sequencing and protein analysis, health testing, and the analysis of drug interactions reduce their time to market for new pharmaceutical products.

[Drug Cardiotoxicity Prediction on OCI](#)

Higher Education & Research

Higher education and research institutes generate a lot of Intellectual Property (IP) across different scientific areas like drug discovery, genomics, weather forecasting, space exploration, and more. These Oracle customers leverage HPC on OCI to run large-scale computations fast, at superior performance, and with lower costs. Many renowned universities and research institutes are working with Oracle to accelerate the development of vaccines, advance understanding of climate change and find solutions to more complex scientific and global problems.

[Oracle for Research](#)

Financial Services

Financial applications, including trading applications, require high-performance, low-latency infrastructure, and consistent performance. Oracle Cloud Infrastructure provides the performance characteristics, such as the sub 2 microsecond in-cluster latency these applications require. This rivals custom-built and expensive on-premises solutions and delivers the results customers need to enable these applications.

[BJSS Boosts HPC by 5x on OCI](#)

High Technology

With the explosion of business data ranging from customer data to the Internet of Things (IoT), data scientists need the flexibility to explore and build deep learning models quickly and with more flexibility than traditional on-premises. OCI provides GPU compute instances for deep learning, easy-to-deploy images, and the flexibility to run a single-GPU workstation or cluster of multi-GPU shapes.

[DeepZen Turns Text into Speech with OCI](#)



Industry Spotlight: Life Sciences and Pharma

The underlying drivers of the pharmaceutical industry remain strong, such as an aging population, prevalence of chronic conditions, demand for treatments of rare conditions, and emerging novel viruses. A recent core focus for industry transformation is addressing drug development cost structures and improving effectiveness. Not only are current processes lengthy and costly but producing therapies to support organizations sufficiently to cover these massive efforts is now a top priority. Oracle's technologies in high-performance computing, advanced analytics, artificial intelligence (AI), and machine learning are core components in transforming the economics of pharmaceutical R&D productivity.

Accelerating drug discovery with HPC and AI

HPC and AI are increasingly being used by pharma organizations to probe vast amounts of raw human biological data to discover new insights into clinical causes of human disease and new opportunities for diagnosis and treatment. Manchester Metropolitan University and NHS use AI to identify diabetic foot wounds and reduce foot-ulcer-related visits by an expected 50%.

Bioinformatics

Genomic sequencing is one of the most-important HPC use cases under the bioinformatics umbrella. Significant growth in available computing power has made challenging sequencing problems, such as whole genome sequencing (WGS), computationally feasible and financially viable. HPC plays an important role in making WGS feasible, and fuels advances in high throughput or next-generation sequencing (NGS). The [University of Bristol](#) in the UK uses Oracle HPC to analyze imaging data for medical research.

Virtual human

Designing medical devices, such as heart valves, stents, and pacemakers, requires careful consideration of the human body's interior structure. When it comes to implanting a device inside a vital organ, there is no room for error. Imaging modalities, such as X-rays, MRIs, and CT scans, provide two-dimensional images of internal organs. A composite model can be created using these images, which provides a three-dimensional, virtual representation of the human body. [ELEM Biotech](#) generates 3D models of human organs from patient scans and replicates their operation on supercomputers. This provides an almost unlimited virtual clinical trials platform based on virtual patients.

Personalized medicine

Personalized medicine identifies the most suitable treatment plan for a patient based upon genetic information. An example of precision medicine is seen in cancer treatment, where the genomic sequence of tumor cells is used in identifying the mutation that was responsible for the disease. Identification of a particular mutation in genomic sequence helps in pinpointing the most effective treatment. The flexibility to scale up sequencing analysis on Oracle Cloud Infrastructure HPC can help identify the best treatment plan in less time and improve clinical outcomes through wider adoption of precision medicine. [LNBio](#) leverages Oracle HPC to identify drug molecules that target COVID-19 viral proteins.

Healthcare Customer Success



"With [Oracle Cloud Infrastructure](#), there's no need to queue requests or schedule simulations. Our customers can access an unlimited number of machines, CPUs, or GPUs whenever they need them—without having to pay for unused capacity when they don't."

Mark Ross
Cofounder and CEO
GridMarkets



"We processed the large data sets obtained by the microscope on the cloud in a fraction of the time and at much lower cost than previously possible. We took a 90-day process and completed it in under five days with Oracle Cloud HPC."

Christopher Woods, EPSRC Research Software Engineer Fellowship
University of Bristol



"Our challenge is to make our simulation program as accurate and efficient as possible. We need a cloud platform that is flexible, powerful, and secure. We get that from Oracle."

Mariano Vazquez
Chief Technology Officer
ELEM Biotech



“Around the globe, virtualization is helping enterprises stay productive during these challenging times. With Quadro Virtual Workstations on Oracle Cloud, creative and technical professionals can easily access the performance they need to work anywhere.”

Anne Hecht, Senior Director of Virtualization Product Marketing
NVIDIA



“Enterprises rely on Rescale intelligent cloud automation to simplify computational engineering workflows and accelerate time-to-solve with application-aware hardware performance intelligence. Oracle Cloud Infrastructure provides a unique set of high performance computing options with bare-metal performance, agility, and low cost. Using Rescale and OCI, our customers are seeing unprecedented levels of automation and performance to help engineering-driven organizations commercialize new innovations faster.”

Edward Hsu, Chief Product Officer
Rescale



“Our close partnership with Oracle Cloud is a win for our customers and prospects who want HPC in the Cloud. With OCI integration built-in to Adaptive Computing’s On-Demand Data Center interface, customers can automate and run jobs seamlessly in the cloud with performance levels comparable to their on-premises systems. Together we are offering organizations of all sizes superior capabilities at the most competitive price.”

Art Allen, CEO
Adaptive Computing

Partner Ecosystem

Oracle has partnered up with commercial and open-source Partners who build and test applications on Oracle Cloud Infrastructure. These applications come vetted by Oracle and are available to all customers:



Oracle Cloud Marketplace

Oracle Cloud Marketplace is a one-stop-shop platform where Oracle customers can shop for business applications offered by Oracle partners on Oracle Cloud. OCI Marketplace also brings together all the contracts, terms, and conditions that each customer has agreed to with their external vendors. This simplifies the use of cloud solutions and ensures customers know exactly what they purchased. The marketplace allows customers to evaluate, select, and deploy end-to-end solutions seamlessly while automating the deployment process.

The Oracle Cloud Marketplace includes OCI HPC partners, giving customers the opportunity to deploy third-party solutions in a complete HPC cloud environment all with one click.

Explore: [Oracle Cloud Marketplace](#)

Get Started: [Oracle Cloud Marketplace Partner Portal](#)



Additional Resources

Learn More About the Solution

- [OCI HPC solution page](#)
- [Computational Fluid Dynamic on HPC](#)
- [GPU – Virtual Machines and Bare Metal](#)
- [Customer Stories](#)

Blogs, Whitepapers, & Industry Reports

- [Intel’s Newest Ice Lake Processor](#)
- [NVIDIA A100 Bare Metal Performance on OCI](#)
- [University of Bristol – Simulating SARS – CoV-2 Protein Dynamic with HPC](#)
- [How Digital Product Design Thrives on OCI](#)
- [Bringing HPC to drug discovery and healthcare](#)
- [Intersect360 Report](#)

Technical Assets & Tutorials

- [Deploy molecular dynamics and GROMACS applications](#)
- [Deploy molecular dynamics and NAMD applications](#)
- [Deploy genomics applications framework and NVIDIA Clara Parabricks](#)
- [Oracle Architecture Center](#)

Try It Yourself with Our Workshops!

- [Provision HPC Cluster Workshop](#)
- [NAMD – Scalable Molecular Dynamics Workshop](#)
- [GROMACS Deployment through Resource Manager Workshop](#)

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