

# Hitachi CMOS Annealing Cloud Service solves large-scale problems

## HITACHI Inspire the Next

### Software and services

Red Hat® OpenShift®

Red Hat OpenShift  
Data Foundation

In 2015, Hitachi Ltd. independently developed complementary metal oxide semiconductor (CMOS) annealing, a specialized technique for solving what is known as combinatorial optimization problems, by simulating the mechanism of quantum annealing—a quantum computing technique—on a semiconductor. This technology makes it possible to rapidly solve extremely complex and large-scale computational tasks. In 2022, Hitachi launched the CMOS Annealing Cloud Service to meet an even wider range of user demands. The service’s cloud-native platform uses Red Hat OpenShift to ensure efficient resource utilization and provide an efficient and security-focused application release environment.



### Manufacturing

No. of employees: **28,672**  
(March 2023)

Group companies: **696**

### Benefits

- ▶ Cut costs by around 72% through resource aggregation with containerization
- ▶ Reduced lead times and costs by using Universal Base Images
- ▶ Delivered a consistent user experience and integration with Red Hat OpenShift

“Thanks to Red Hat OpenShift, we now have an environment in which we can quickly develop and run systems.”

**Jun Ogawa**  
Chief

Department 3  
Financial Information System Business Unit 2  
Financial Information Systems 1st Division  
Hitachi, Ltd.

“Red Hat OpenShift is constantly being improved and upgraded, even while it’s being run. I’m very confident that we’ll continue to use it and create systems together.”

---

**Hirokazu Nakamura**

Engineer

Group 2

New Business Promotion Section

Financial Information System Business

Unit 2

Financial Information System

1st Division

Hitachi, Ltd

## Supporting practical use of CMOS Annealing using cloud services

There are currently two types of quantum computers being developed by research institutions and companies around the world: gate-based quantum computers and annealing-based (or Ising-type) quantum computers. Almost all of these computers require extremely low-temperature environments – close to absolute zero – to run. Of these two types, Hitachi has successfully implemented a technique that works for the same purpose as an annealing-based quantum computer, but uses semiconductor technology. CMOS Annealing is a quantum-inspired computing technique that operates at room temperature.

“CMOS Annealing is a computing technique that uses conventional semiconductor technology, but can solve combinatorial optimization problems, which have been difficult to solve with conventional technology, very quickly. Since it can find an applicable solution (or a practical solution) rapidly from among a large number of options, you can really feel how advanced the technology involved is when you give it large-scale problems,” said Jun Ogawa, Chief of Department 3, Financial Information System Business Unit 2, Financial Information System 1st Division.

There are many situations that require combinatorial optimization, such as shift scheduling, portfolio management, traffic congestion elimination, railway operation management, logistics, shipping, and inventory management. CMOS Annealing has already achieved results in optimizing work shift scheduling and portfolio management and will be provided as a cloud service that is easy to deploy in order to expand its fields of use.

“With a cloud service, in addition to CMOS Annealing functionality, applications and support are provided as a single package,” said Mr. Ogawa. “Users aren’t required to have any specialized knowledge of development environments, building and maintaining applications, or physics and math. Everyone will be able to use this service with peace of mind, no matter the industry or scale.”

Hitachi’s CMOS Annealing Cloud Service covers a broad range of industries, so its platform requires flexibility and high security. Red Hat OpenShift met this infrastructure requirement and was chosen as the most suitable platform.

## Adopting Red Hat OpenShift for cloud-native infrastructure

In building the infrastructure for the CMOS Annealing Cloud Service, Hitachi focused on creating an environment for independent operation on shared infrastructure. “Solving combinatorial optimization problems is required in every field, so we’re developing multiple solutions using CMOS Annealing concurrently. However, managing it all effectively and efficiently is quite a challenge, as the different development tasks have varying levels of difficulty, and start times and progress vary. So we decided to use container technology to orchestrate it all,” said Mr. Hirokazu Nakamura, an Engineer with Group 2, New Business Promotion Section, Financial Information System Business Unit 2, Financial Information System 1st Division.

Many technologies and products use Kubernetes as an engine, but Mr. Nakamura says Red Hat OpenShift was the first to catch his eye. “Red Hat OpenShift has a proven track record in enterprise systems around the world, and we could see how reliable it was. We thought the OperatorHub and Universal Base Image (UBI) functionality would be useful for our developers, and we saw that they would contribute significantly to simplifying operations. The developer-friendly functions offered by Red Hat OpenShift were another deciding factor in our decision to adopt.”

“When providing services in the cloud, it is extremely important to respond quickly when vulnerabilities or problems occur,” said Mr. Nakamura. “Red Hat has a great support system for things like that, which was very reassuring.”

### **Accelerating innovation with Red Hat OpenShift**

#### **Cut costs by around 72% through resource aggregation with containerization**

With Red Hat OpenShift in place, Hitachi no longer needs to set up individual virtual machines (VMs), resulting in significant cost savings.

“Conventional virtualization required three environments for one solution. CMOS Annealing, as a dedicated machine, provides a user area to run user applications by multiple users in a common environment,” said Mr. Ogawa. “Many aspects of solution development move forward concurrently, meaning the number of VMs in use is quite high; however, any excess capacity a VM might have can’t be diverted to other VMs. With a container environment, we can run multiple applications on a single node, which allows us to make effective use of excess capacity.”

By being able to optimize the use of VM resources in a container environment, Hitachi was able to cut costs by about 72% compared to setting up individual VMs.

#### **Reduced lead times and costs by using Universal Base Images**

The use of a UBI, a Red Hat Enterprise Linux® container image, was highly effective in moving to a cloud-native system.

“Using a UBI, you can create an image that packages the middleware and libraries needed to run applications, and the image can be used as is in other containers,” said Mr. Nakamura. “Normally, getting each host’s operating system and all the products together takes time and effort, and you have to examine each development system, including support, one by one. But by using a UBI, we were able to eliminate wasteful procurement costs and significantly shorten the lead time for building a system.” Mr. Nakamura adds that UBIs will be extremely useful in developing the cloud service in the future. “We expect demand for the CMOS Annealing Cloud Service to continue to grow, and we will also have to refine our applications as we are presented with new requirements. The middleware we want to use will probably also change. Having a highly portable UBI will let us carry out verification more flexibly.”

#### **Delivered a consistent user experience and integration with Red Hat OpenShift**

Using a container environment also helps save developer time in testing. “From the start of testing in the development environment to final deployment in the production environment, developers have to conduct repeated testing while checking system differences,” said Mr. Nakamura. “We’ve been able to reduce such differences between environments by taking advantage of the portability of containers, allowing us to achieve a surprising reduction in testing manpower.”

In terms of savings, Mr. Ogawa points out that Nvidia’s GPU Operator allows his team to effectively utilize GPU resources. “Installing GPU Operator is straightforward with Red Hat OpenShift’s OperatorHub. GPU Operator is equipped with the requisite components for running Nvidia GPUs, making it easy to use and share GPU resources, allowing us to make better use of our resources.”

Likewise, Red Hat OpenShift Pipelines, which can be installed with OperatorHub, helps create cloud-native continuous integration and continuous delivery (CI/CD) pipelines. “Thanks to Red Hat OpenShift, we now have an environment in which we can quickly develop and run systems,” said

Mr. Ogawa. “We have achieved integration by adopting Red Hat OpenShift, including the partnership with Red Hat OpenShift Data Foundation, which provides the storage necessary for data sharing.”

### Supporting industries with CMOS Annealing

According to Mr. Ogawa there has been a great reaction to the release of the CMOS Annealing Cloud Service, and that they can see signs of new business development.

“We are receiving inquiries from many companies. In addition to companies that are considering deployment, we’ve also received many offers to do business using the cloud service,” said Mr. Ogawa. “Many of these companies have solutions in the form of their own products, but there also seems to be a desire to use CMOS Annealing as a computation engine to boost the added value of those products.”

With its capacity for use as a cloud service, being able to add value while keeping investment costs down is attracting new businesses. “CMOS Annealing is a technology that’s needed in today’s society, and I’m sure it can support all kinds of industries,” said Mr. Ogawa.

Mr. Nakamura also sees significant benefits in collaborating with Red Hat. “The promotion we’ve done with Red Hat gave us an opportunity to publicize CMOS Annealing to people who had never heard of Hitachi’s technology before, which led to the creation of new users,” said Mr. Nakamura. “Red Hat OpenShift is constantly being improved and upgraded even while it’s being run. I’m very confident we’ll continue to use it and create systems together.”

In regard to the future development of the CMOS Annealing Cloud Service, “A news release on a Proof of Concept (PoC) for Vietnam Post was issued on July 6, 2023, and we are considering global expansion in the future. As the number of use cases for CMOS Annealing for rapid solution of combinatorial optimization problems increases around the world, we will undoubtedly be able to acquire expertise that will come in handy once quantum computing is a reality,” said Mr. Ogawa.

### About Hitachi, Ltd.

Hitachi drives Social Innovation Business, creating a sustainable society through the use of data and technology. We solve customers’ and society’s challenges with Lumada solutions leveraging IT, OT (Operational Technology) and products. Hitachi operates under the business structure of “Digital Systems & Services”—supporting our customers’ digital transformation; “Green Energy & Mobility”—contributing to a decarbonized society through energy and railway systems, and “Connective Industries”—connecting products through digital technology to provide solutions in various industries. Driven by Digital, Green, and Innovation, we aim for growth through co-creation with our customers.

### About Red Hat

Red Hat is the world’s leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers develop cloud-native applications, integrate existing and new IT applications, and automate and manage complex environments. [A trusted adviser to the Fortune 500](#), Red Hat provides [award-winning](#) support, training, and consulting services that bring the benefits of open innovation to any industry. Red Hat is a connective hub in a global network of enterprises, partners, and communities, helping organizations grow, transform, and prepare for the digital future.



#### About Red Hat Innovators in the Open

Innovation is the core of open source. Red Hat customers use open source technologies to change not only their own organizations, but also entire industries and markets. Red Hat Innovators in the Open proudly showcases how our customers use enterprise open source solutions to solve their toughest business challenges. Want to share your story? [Learn more.](#)



[f facebook.com/redhatinc](#)  
[@RedHat](#)  
[in linkedin.com/company/red-hat](#)

**North America**  
 1 888 REDHAT1  
[www.redhat.com](#)

**Europe, Middle East,  
and Africa**  
 00800 7334 2835  
[europe@redhat.com](#)

**Asia Pacific**  
 +65 6490 4200  
[apac@redhat.com](#)

**Latin America**  
 +54 11 4329 7300  
[info-latam@redhat.com](#)