

# OpenStack – The open source standard in cloud computing



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# 1. Introduction:

## An overview of OpenStack

Open source software has become an integral part of the corporate world. Companies looking to leverage cloud computing essentially have two options: Hyperscalers or open source offerings, which offer insight and influence due to their open source nature. Unlike hyperscalers, open source installations can be operated in both public and private modes. This whitepaper is therefore focused on the open source software OpenStack, which is now being used productively in a wide range of public and private clouds.

Chapter 2 of this white paper provides an overview of the OpenStack platform and details about the structure of the individual modules. Chapter 3 provides information about the genesis of OpenStack and the companies that support the development of this cloud software. Chapter 4 presents the “Four Opens”: These principles form the working basis of free and equal software development within the framework of OpenStack. Chapter 5 shows how this open approach can be reconciled with data protection and quality assurance. In Chapter 6, the analysts have their say: Assessments by experts, market data, and survey results provide information about the spread of OpenStack to date and its future prospects. Chapter 7 compares OpenStack with the offerings of hyperscalers – an important difference lies in the deployment model: OpenStack, in contrast to AWS, Azure & Co. also enables the establishment of a private cloud. Tools such as Kubernetes, which as open source software can be easily integrated with OpenStack,

are essential for the management and control of applications in cloud landscapes. Chapter 8 provides an overview of these.

Examples from the Open Telekom Cloud, whose services are based on OpenStack, illustrate how the technological and conceptual principles of OpenStack can be implemented in practice. Finally, in Chapter 9, users from the OpenStack community and customers of T-Systems demonstrate the advantages OpenStack offers to organizations and companies in its everyday use.



**First, the basics:**  
What exactly is OpenStack?

# 2. The cloud's operating system: What is OpenStack?

To answer the question “What is OpenStack?” it’s useful to compare the cloud to a PC: Similar to a computer’s operating system, which manages system resources such as memory and hard disks and makes applications available, the OpenStack software platform serves to manage the diverse hardware components in a cloud and coordinate their interactions. In this way, users can be provided with highly-scalable computing, storage, and network capacities as well as other IT and telecommunications resources. The Open Telekom Cloud is based on OpenStack and uses this cloud “operating system” to control several halls full of hardware covering a total area of around 21,000 square meters. These are distributed across T-Systems’ geo-redundant data center sites in the German state of Saxony-Anhalt and the Dutch metropolitan region of Amsterdam.

## What does OpenStack consist of?

### Computing resources, storage, and more

Similar to Linux software, which companies usually get as a package from professional distributors such as Red Hat and Canonical, OpenStack is not software that users download from a server and immediately start to use. OpenStack consists of a combination of core components that were developed independently and interact with each other.

The central services include the Nova compute module, which is used to manage and control servers and virtual machines (VMs). The Cinder service can be used to provide virtualized block storage, and users can obtain object storage via Swift. Managing networks and IP addresses is the task of the Neutron network service. The Horizon module provides an easy-to-use graphical user interface (GUI) which is used to map the most important functions of the OpenStack services. The console of the Open Telekom Cloud, for example, is based on Horizon.

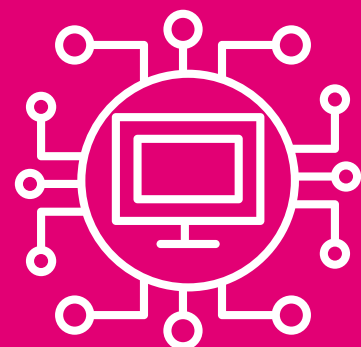
### Manage user rights and control module interaction

The Keystone module is used to manage user rights and ensure the secure authentication of clients and users. Among other things, it regulates which modules are allowed to communicate with each other. For example, when the Cinder storage service receives a request to provide storage for a particular user and therefore attaches a virtualized disk to a server, three modules interact: Keystone authorizes, Cinder provides storage, and Nova takes care of setting up the server. A total of around 50 modules can be used and linked to each other. The modules provide virtually all the infrastructure components and resources, including virtual servers, hard disks, and networks, that are required by the services based on them. OpenStack can thus also be understood as the virtual management of a data center at the infrastructure level.

→ Chapter 9 provides detailed application examples based on references and use cases.

### Combinable with containers, Kubernetes & Co.

In accordance with the principle of openness, OpenStack can also be combined with many open source systems and tools. These include, for example, container solutions such as Docker and frameworks such as Kubernetes (see also Chapter 8). Not every user will need everything that OpenStack provides – the Open Telekom Cloud also uses its own supplementary software. Telekom obtains any other hardware and software from its distributor in a customized OpenStack package. The Telekom experts test this thoroughly once again to make sure that it meets both OpenStack and Telekom’s own specifications. It’s only then that they play out the software for the Open Telekom Cloud, in order to run customer applications.





# 3. A software celebrates its 10th anniversary: How did OpenStack come about?

What began in 2010 with a collaboration between the US-based IT provider Rackspace and the space agency NASA on the coordinated use of Rackspace servers has long since gone beyond this initial project: OpenStack has become a global community and is governed by a foundation that by the end of 2020 already had around 100,000 members in 187 countries.

During this time, many companies and members have constantly further developed the cloud software platform. Since 2010, two releases have been published each year, whose names follow the letters of the alphabet: While the first release in 2010 was called “Austin,” the name of the version released in March 2022 is “Yoga” – and its successor “Zed” is already in development. 680 developers from 125 companies and organizations have contributed to “Yoga.” In total, OpenStack now has a code base of more than 20 million lines contributed by its members.

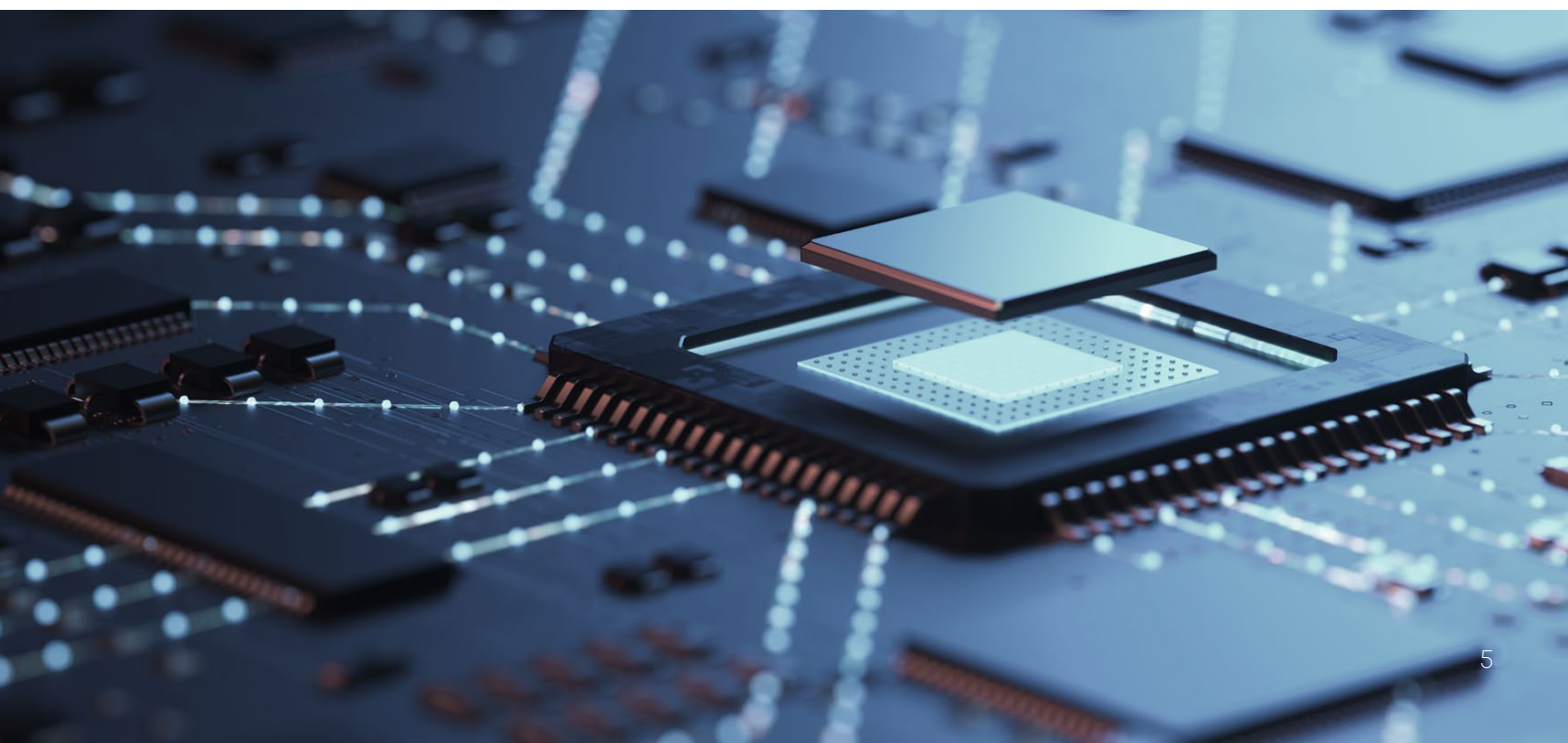
## **On board: A who's who of the industry**

Many well-known IT companies have found the community project so interesting that they have joined as members, assigned staff resources to OpenStack development, and support the foundation. In addition to Deutsche Telekom, other industry heavyweights are joined, including Dell, Cisco, IBM, and HP, as well as renowned Linux distributors such as Red Hat and Canonical.

## **Openness, transparency, and equality**

A major contribution to OpenStack's success has been its open and egalitarian organizing principle: It is not a project dominated by one single vendor. Individual developers are on board just as much as large IT companies and cloud providers. In 2012, the OpenStack Foundation was established, providing OpenStack with its organizational framework. Since the end of 2020, the foundation has been called the Open Infrastructure Foundation (OIF). The new name is intended to express the idea that the development is by no means at an end and that the focus goes beyond OpenStack to open source infrastructure software.

After 10 years, OpenStack and its foundation are now an established force – comparable to the Linux and Apache foundations and the CNCF (Cloud Native Computing Foundation). Professional software development is driven forward on the basis of solid financial funding and the support of numerous companies. Deutsche Telekom is a Gold Member of the foundation and supports its work with a substantial dollar amount every year.



# 4. The OpenStack approach: What are the “Four Opens”?

The open structure and organizational form is expressed in the “Four Opens”, which are both the motto and the working basis of the OIF: Open Source, Open Design, Open Development, Open Community. What is behind these principles in detail?

**Open Source** means that the software developed is actually freely usable and scalable for everyone and has no limitations in terms of features, functions, and performance. Open source software (OSS) can essentially be used for any purpose, makes the code visible, and offers the possibility of modifying it. In contrast to other OSS, OpenStack does not publish any “enterprise editions.”

The commitment to **Open Design** specifies that the development cycle for a new release will be an open process that involves the entire member community – developers, businesses, users, and project leaders. Requirements are gathered, specifications written, and priorities defined at events and conferences. This is how the community manages and controls the design process. Everyone involved has the opportunity to influence the development of the software in such a way that it meets their own needs and requirements.

**Open Development** is enabled by a Git repository where source code is accessible throughout the development process. As part of the public code review, every community member is given the opportunity to participate in the development from the very first line of code and to not only write code, but also review and test it.

Finally, a lively user community that is open to discussion is essential for a successful collaboration: the **Open Community**. All the processes and project meetings run openly and transparently and are documented – and all the participants deal with each other on an equal footing: every voice is heard, and anyone can be elected to leadership positions in development teams. It is important to define common goals and create strong connections between all the participants, because working in silos is poison for a vibrant community and a functioning OpenStack ecosystem.

Thus, the Four Opens describe a comprehensive approach to software development from idea to design to delivery. The Four Opens have emerged in the community in a way that is specific to OpenStack and at the same time reflect the principles of open source.



# 5. Data protection and quality assurance:

## How does OpenStack maintain the balance between openness and security?

The principles of openness and the public code review (Open Development) are compatible with security requirements and don't provide cybercriminals with ways to access systems and data. First of all, data is strictly separated from code anyway. The code merely provides the blueprint for the virtual machines and modules on the basis of which data is later generated during the application operation. If the code of such a system is cleanly executed, attackers have no way of accessing it from the outside, even if the documentation is openly available – it's comparable to a lock whose mechanism is known, but which offers no external points for attack because it is bolted from the inside. The open and distributed code review, therefore, does not represent a security risk, but is one of the strengths of OpenStack.

### Multi-level quality assurance

The web-based Git service, which OpenStack uses as a central repository for version management, also contributes to the secure development of the source code. Before the code is packaged for delivery to users, it goes through a rigorous quality assurance process. Anyone who sends in contributions to the code development doesn't have direct write access to the code that has already been reviewed and found to be good, and that is stored in the repository as the current version. The public review takes place at a preliminary level below, in a server environment that is also protected: At least two experienced developers must independently review the code contribution and give their approval before new lines of code are added to the current version.

To relieve the usually busy development experts of some of their work and to ensure continuous integration (CI), the OpenStack community also uses the CI software Zuul, which can be used to perform automated technical tests. This is because every change in a line of code can have a significant impact on the overall system. So, this test system first checks whether the OpenStack structure

remains executable after a submitted code change. Even a forgotten semicolon in the code could cripple an entire virtual machine fleet and cause modules such as Keystone, Nova, and Cinder to stop interacting.

Quality assurance thus follows the test cycle, including load and performance tests, as is common in software quality management. Once the tests and code review have been successfully completed, the release is handed over to the distributors, who in turn carry out tests and any adjustments for their respective hardware and software. Finally, organizations and companies such as Telekom, which purchase the hardware and software packages from their distributors, also perform test runs again to ensure compatibility with their own specifications.



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employees in Telekom's Delivery team are assigned to quality assurance tasks for OpenStack.



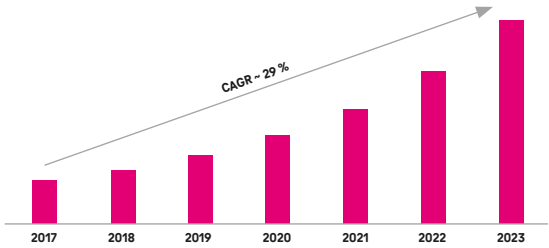


# 6. Figures and assessments from analysts: How strong is OpenStack's growth?

Not only is the OpenStack community growing, but the adoption of the cloud software by companies is also increasing. Back in 2018, market researchers at Forrester wrote: "The numbers speak for themselves: more than 50 percent of Fortune 100 companies use OpenStack (...) and a third of global enterprise infrastructure decision makers see expanding the use of open source as a critical or high priority."<sup>2</sup>

**OpenStack is growing at an average annual rate of 29 percent**  
Analysts at Market Research Future estimate the total global volume will be around 8 billion dollars by 2023, with a compound annual growth rate (CAGR) of 29 percent (see chart).<sup>3</sup>

If the market volume for OpenStack grows, then spending on cloud services will also increase – and strongly, according to the forecast by the experts at Gartner. In 2022, global end-user spending on public cloud services is expected to have risen by 20.4 percent to 494.7 billion dollars, and even to an estimated 600 billion dollars in 2023. Gartner figures show the greatest growth for Infrastructure as a Service (IaaS). This will grow by 30.6 percent year-on-year in 2022.<sup>4</sup>



(Source: OpenStack Service Market Research Report – Forecast to 2023, Market Research Future)



# 7. No vendor lock-in and GDPR compliant:

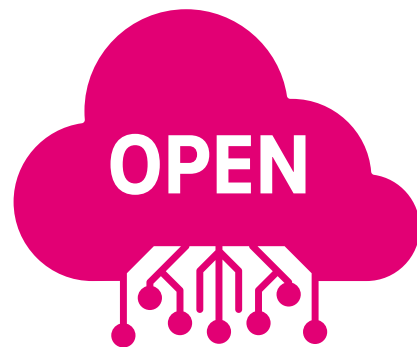
## Why does OpenStack offer an alternative to hyperscalers?

In purely functional terms, there is little difference between OpenStack and the solutions of the large hyperscalers from the United States such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP), as well as Alibaba and Tencent from China.

A typical application that is cloud-ready or can be easily configured for a cloud will run equally well anywhere. Via an API interface, users can control the individual functions of their cloud and create and configure new hard disks, data storage, databases, networks, and virtual machines as required. The differences lie more in the details. For example, Microsoft Azure has focused on functions for the Internet of Things (IoT), while GCP has focused more on artificial intelligence (AI) – the market remains in constant flux.

One advantage over hyperscalers, which operate with proprietary software, lies in the open software standard: Those who use OpenStack are not tied to one manufacturer (vendor lock-in) and don't run the risk of encountering almost insurmountable hurdles when switching to another provider. In addition, hyperscalers often have hidden costs for so-called data take-out.

Another advantage is related to the production and data storage location of the respective cloud providers: Anyone who works with personal data as a user of cloud services in Europe must ensure that this data is not processed in third countries that do not offer an adequate level of data protection. Cloud providers based in Europe that host their OpenStack-based cloud solution at European locations fulfill this requirement. US and Chinese providers cannot do this even if they produce their cloud in Europe: They are obliged to pass on user data from servers located in Europe to their domestic authorities when requested to do so. The international legal situation is opaque: Ever since the Privacy Shield, which previously regulated data transfers to the US, was declared obsolete by the European Court of Justice in the Schrems II ruling of July 2020, there has been a lack of clear rules. According to a study by the Center for European Policy, for example, there is a risk of penalties if personal data is stored in US clouds and, therefore, not in compliance with the GDPR.



### OpenStack deployment model offers more choice

In addition, OpenStack's deployment model accommodates companies that do not want to move from an on-premises installation, or directly to a public cloud. They have the option of migrating their IT landscape to a private cloud with OpenStack – this option of private instances does not exist for users of AWS, Azure, and GCP. As a result, OpenStack has become a regular standard for companies using private cloud infrastructures.

In addition, the move to the private cloud offers a company the opportunity to explore the potential of OpenStack for its own purposes and to carry out feasibility studies (proof of concept). This can be carried out on a test basis on a laptop with a mini-stack or on a larger scale corresponding to the practical operation, for example with a dozen computers in the company's own server room or data center. If an IT department determines after six months of project runtime that an OpenStack installation is working as desired, but would tie up too many resources in the long term as a private cloud, the shift to the public cloud of an OpenStack provider is straightforward: A simple migration path from OpenStack private to OpenStack public can be defined.

# 8. Working with Docker, Kubernetes, Terraform & Co.:

## How does OpenStack harmonize with third-party software?

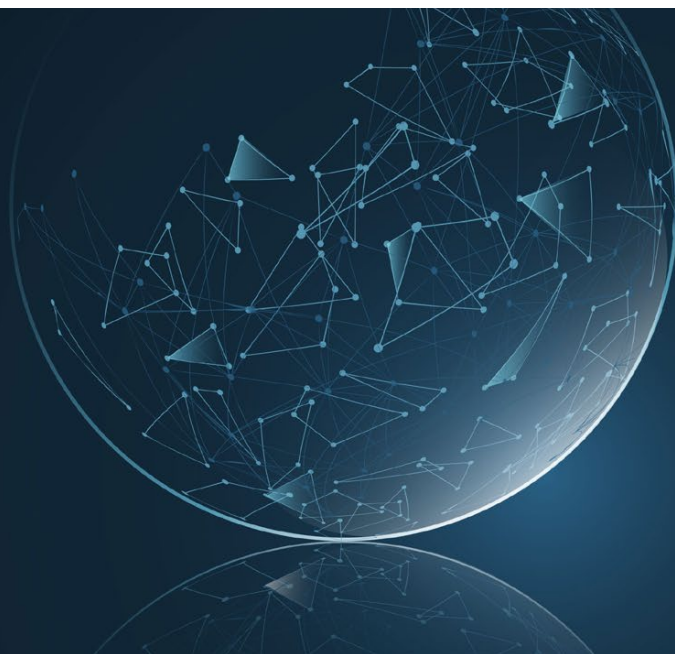
Apps have become a standard in IT. The lightweight applications have also long become established in cloud computing. Packaged in handy containers, they can be easily moved to the server or cluster in the cloud data center where they are needed. And can be deployed immediately: Containerized applications come with a complete runtime environment, regardless of the operating system or libraries. One of the most widely used container tools is Docker.

It makes sense to use an orchestration tool like Kubernetes to manage growing numbers of containers. The open source system automates the deployment, scaling, and management of containerized applications on distributed hosts. Kubernetes allows many instances of the same container to be launched. If a container fails or reports an error, a copy automatically takes over. This provides more speed and standardization compared to the traditional software installation, where administrators have to work through package by package, directory by directory, and customize configuration files before a software application is ready to run on a host.

Thanks to Docker & Co., working with cloud landscapes can be simplified and accelerated considerably. For example, DevOps teams can develop software agilely and move it quickly via containers, such as from a test to a production environment.

### **Faster deployment, simplified migration**

Docker and Kubernetes run with hyperscalers such as Google, AWS, and Azure, as well as OpenStack-based clouds. System administrators can either install the tools themselves in the OpenStack cloud or use one of the OpenStack modules such as Magnum or Zun. Or they can use a platform service from their cloud provider, such as Open Telekom Cloud's Cloud Container Engine (CCE), which is based on Kubernetes and compatible with Docker. CCE enables the building of containers with virtual machines. Via Kubernetes/CCE, for example, complete cloud environments with containerized software can be easily migrated from one OpenStack-based cloud to another.





### **Simplified control through tools ecosystem: Rancher, Zuul, Ansible, and Terraform.**

Tools such as the open source Rancher tool can be used to control and manage containers and entire Kubernetes clusters across different cloud environments. The software addresses operational challenges as well as security requirements that arise from working with Kubernetes clusters in different environments. As a result, Rancher is particularly suitable for use in multi-cloud landscapes. Rancher's support is also very helpful for DevOps teams working in distributed environments and infrastructures.

The Zuul program is also available to support DevOps and the accelerated development of software using CI/CD methods (continuous integration, delivery, and deployment). Like the OpenStack community, Telekom also uses the Zuul infrastructure for continuous development and integration.

Ansible is another useful automation tool. It is also an open source development and is used for the administration of IT systems, configuration management, and software distribution. The entry thresholds for working with Ansible are set deliberately low: Only the OpenSSH file transfer program package and the Python programming language need to be present on the systems to be managed. Ansible is operated via the simple YAML markup language. Among other things, it enables users to automate the process of recurring tasks without advanced programming knowledge. An extension package, called a collection in the Ansible context, is available for managing cloud resources.

The Terraform tool can be used to provision infrastructure such as servers, data storage, networks, and other required resources. It enables system administrators to define code in a simple scripting language (Infrastructure as Code, IaC) and to simplify and automate resource management. With the help of Terraform, IT resources can be described in a standardized way and transferred and rolled out to different cloud environments without requiring separate configuration by an administrator at each individual cloud provider. Terraform carries this out via the API of the respective provider. Terraform also detects changes in an existing configuration and executes the resulting steps.

Thus, Terraform's multi-cloud and management capabilities make it possible to deploy and maintain different public clouds, private instances, and other services with just one workflow. Integrations for numerous clouds are available for Terraform. In addition to public clouds, these include DevOps environments, infrastructure software, databases, networks, and software tools.

Around a dozen employees at T-Systems are working on the ecosystem of third-party tools for the Open Telekom Cloud. They are actively involved in the development and quality assurance of open source tools such as Kubernetes, Rancher, Ansible, Terraform, and Zuul. And to do so, they are in constant exchange with the respective communities. As a result, the integration of open source tools into OpenStack-based cloud environments such as the Open Telekom Cloud is usually a mere formality.





## 9. Application examples and references:

From the research center to the financial services provider, from the large corporation to the start-up.

### **In OpenStack in the service of cancer research**

The Canadian city of Toronto is home to the Ontario Institute for Cancer Research (OICR). In 2018, it received the OpenStack Super-user Award in recognition of its Cancer Genome Collaboratory's contribution to cancer research. OpenStack had enabled the OICR to build the Cancer Genome Collaboratory. The cloud behind it allows researchers to access the world's largest and most comprehensive cancer genome dataset.

This gives scientists the ability to perform complex analyses with a large data pool of genome sequences. Instead of spending weeks or even months downloading hundreds of terabytes of datasets from a central data repository and only then beginning their analyses and calculations, researchers can upload their analysis software directly to the Collaboratory cloud, have it work there, and then securely download the calculated results.

The Collaboratory houses the dataset of the International Cancer Genome Consortium (ICGC). This global scientific network was established and funded by more than 40 countries with the goal of mapping the genomes of the 50 most common cancers. Users get quick and easy access to this unique data pool.

### **Open source offers more flexibility and freedom**

All the technologies used for the Collaboratory cloud are open source. In addition to OpenStack, these include the Linux operating system, the Ceph distributed storage solution, the Ansible automation tool, the Zabbix network monitoring system, the Elasticsearch search engine, and the Kibana visualization tool. The OICR IT team also includes two certified OpenStack administrators (COA).

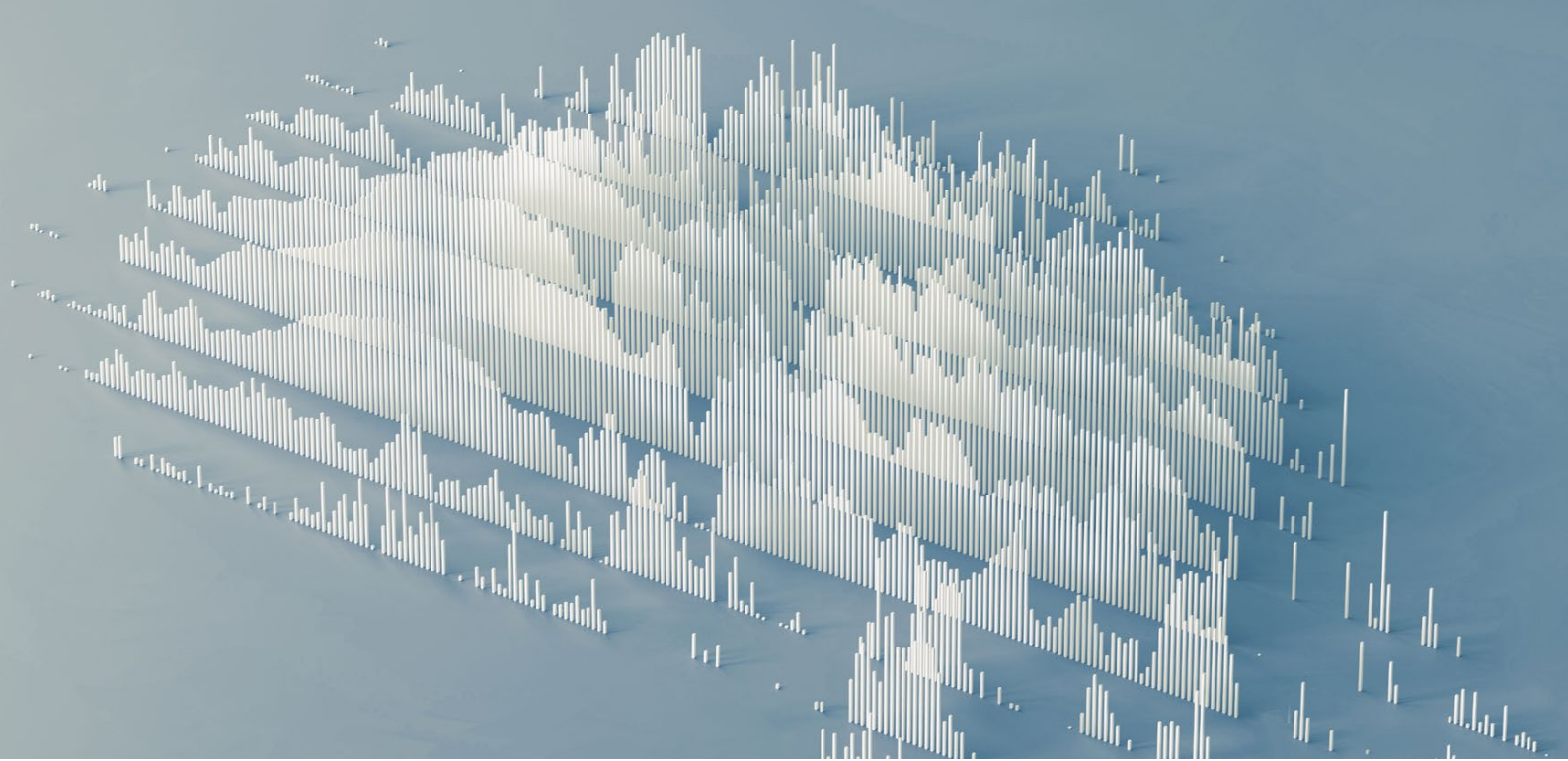
The OICR generally relies on open source because these technologies offer more flexibility and freedom – and the money saved can be invested in increasing research capacity. “We couldn't offer cancer researchers a cloud environment at this scale and price point if we weren't using open source technologies like OpenStack and Ceph,” according to members of the IT team at the OICR.

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research labs across the world are able to access 670 terabytes of protected data on cancer genomes.

As of 2018, the Collaboratory cloud had 2,600 processor cores and 18 terabytes of memory, as well as 7.3 petabytes of storage managed by Ceph. As a result, the Collaboratory cloud contributed to research results published in 43 peer-reviewed scientific papers.





### **Great cost benefits thanks to open source and commodity hardware**

The workloads for cancer genome research have specific requirements for memory, CPU, and RAM – and the Collaboratory cloud provides correspondingly large amounts. “Because of its use of only open source and commodity hardware, the cost for using the Collaboratory is almost 40 percent less than that of the leading commercial cloud provider,” the OICR team members conclude.

### **OpenStack in insurance: Insurance Australia Group (IAG)**

The largest insurance company in Australia and New Zealand, Insurance Australia Group (IAG), is using OpenStack. In addition to these two countries, IAG operates primarily in Southeast Asia and currently employs more than 10,000 people. IAG’s business segments are general insurance, reinsurance, and underwriting, which includes risk assessment. In 2017, the company generated revenues of nearly 12 billion Australian dollars. IAG currently has about 8.5 million customers.

IAG uses OpenStack in separate tenants for pre-production, production, and analytics. The analytics tenant consists of 12 high-performance servers and storage capacities for archiving purposes. This maximizes the performance of IAG’s commercial ScaleIO storage solution. In pre-production, 10 servers (nodes) are used, as well as nL-SAS storage systems using an open source ScaleIO storage solution. The production tenant has 18 servers (nodes) with a mixed storage environment of SSD disks, SAS, and nL-SAS. For processing data workloads, this gives IAG four times the performance of its VMWare environment – and at only one-fifth of the cost. With its OpenStack implementation, IAG supports workloads from “micro” to “8xlarge” and volumes from 40 gigabytes to 18 terabytes per node.

IAG has five certified OpenStack administrators on its team, which built the new end-to-end environment with OpenStack. Team members consider the rapid validation of the proof of concept and the fail-fast system to be particularly useful. This allowed for the seamless migration and updates to the platform.

The OpenStack environment helps IAG with pricing, customer service, marketing, and analytics, as well as with rapid prototypes for data products. As a result, the solution allows IAG and its developers to focus on core customer business without having to worry about the underlying infrastructure.

### **Private cloud deployments with OpenStack: Walmart, Bloomberg, and Fico**

Nearly 560 billion dollars in revenues in the 2021 fiscal year, more than 2.2 million employees, and about 11,500 retail stores: Walmart, one of the world’s largest retailers, is using an OpenStack-based private cloud, in part to develop applications agilely. More than 170,000 processor cores run on OpenStack. In total, 60 open source products are used at Walmart – the core pieces include its own OneOPs cloud and a platform for application lifecycle management that was also developed in-house. In the public cloud, Walmart uses resources from Microsoft Azure.

The media company Bloomberg has also opted for a private cloud based on OpenStack to reflect the company’s high requirements for performance, security, and compliance. Bloomberg started with the OpenStack version “Folsom” and now has more than 3,000 OpenStack instances in three data centers.

The California-based company Fico specializes in analytics-based fraud detection software. Some 2.5 billion credit cards worldwide are protected by the software and 90 percent of all credit decisions are based on Fico’s score system. To support its Big Data Analytics, Fico uses an OpenStack-based private cloud in seven data centers throughout the world.

### Key figures in real time at the push of a button – with analysis software from the Open Telekom Cloud

Current figures on production, projects, processes, and performance: Canri analysis software provides companies with all this – in real time and clearly displayed on dashboards. Canri was developed by the Forsit Group, which was founded in 2015 and brings together specialists in software development, IT services, and SAP consulting. Forsit provides its real-time analytics software as Software as a Service (SaaS) from the Open Telekom Cloud. “More than 90 percent of our projects and software developments are already cloud-based,” says Matthias Piksa, Managing Director at Forsit Group. “On-premises installations are not really in demand anymore. Our customers are consciously turning to the cloud instead.”

With Telekom’s public cloud solution, Forsit customers are safe in the knowledge that the processing of their sensitive corporate data meets the highest standards, such as the European General Data Protection Regulation (GDPR). “In discussions with our customers, we have repeatedly found that T-Systems as the brand behind the Open Telekom Cloud has a positive, trust-inspiring effect,” says Piksa. “That’s a selling point.”

Forsit’s strong customer growth is supported by numerous cloud services from the Open Telekom Cloud. Using the Elastic Load Balancer, loads can be automatically distributed to virtual machines. The Auto Scaling service automatically starts additional resources and turns off those that are no longer needed. The Elastic Volume Service serves as flexible data storage, while the Cloud Server Backup Service is used as an automatic backup and versioning system. This ensures Canri’s high availability and disaster recovery. In addition, Forsit customers have the option of setting up a virtual private cloud and thus an isolated data room within the Open Telekom Cloud, for example to meet compliance regulations.

### Advantages over proprietary systems

The advantages of the open source OpenStack architecture convinced Forsit – the company had previously used a Microsoft Azure environment to develop their Canri software. “The Open Telekom Cloud and its modules are easy to administer because they are based on OpenStack standard technologies,” explains Hüseyin Kilic, IT System Administrator at Forsit. Furthermore, thanks to the Open Telekom Cloud’s open source architecture, Forsit’s customers don’t risk vendor lock-in, as the SaaS applications can be easily ported via Cloud Container Engine (CCE).

Among other things, OpenStack makes the provisioning of processes run faster: “With the help of the practical volume drivers, for example, application data can be swapped out immediately. There are also providers where different services have to be applied for this purpose.” When it comes to scaling and creating clusters, the Open Telekom Cloud is more flexible: “Additional server nodes can be added dynamically and without any downtime during operation via Kubernetes. In addition, with the Open Telekom Cloud’s Kubernetes service we can also set up individual servers and not just complete node pools retrospectively. With proprietary systems, if you want to unbundle a cluster after provisioning, that’s often not possible without some downtime.”

OpenStack is also convenient when it comes to setting up and automating backups. “Backups can be made several times a day in the Open Telekom Cloud, so that we can, for example, back up and encrypt the application statuses before and after the end of operations,” says Kilic. The hard disks for storage are not tied to a specific cluster and can be provisioned flexibly. In general, he says, connecting storage with Kubernetes is straightforward using the Open Telekom Cloud’s “everest-csi-provisioner.”







All in all, with OpenStack and the Open Telekom Cloud, we benefit from higher data throughput, lower maintenance requirements, and a faster deployment of applications.”

**Hüseyin Kilic**, IT System Administrator at Forsit



### **Fast deployment and flexible operation with low maintenance requirements**

As a result, using OpenStack and the Open Telekom Cloud’s modules simplifies the daily administration work for Forsit: “OpenStack has comprehensive functions to control and manage the various workloads of a cloud landscape,” says Kilic. “The Open Telekom Cloud’s intuitive user interface makes it easy to use, and processes such as provisioning and distributing workloads run faster in conjunction with Kubernetes than with other cloud providers.” Because of its speed, the IT systems administrator particularly appreciates the Elastic Load Balancer module, which automatically distributes and switches increasing loads to servers.

The Elastic Volume Service, in turn, provides Forsit with dynamic, disk-based storage resources for virtual machines: “This allows us to roll out applications very quickly and greatly reduce downtime. In addition, we don’t have to maintain the hard disks ourselves,” says Kilic. “All in all, with OpenStack and the Open Telekom Cloud, we benefit from higher data throughput, lower maintenance requirements, and a faster deployment of applications.”

### **Virtual desktop at the click of a mouse – with secure streaming platform from the Open Telekom Cloud**

The name of the Swiss software company says it all: oneclick’s customers open a complete digital desktop in their browser with just the click of a mouse. In doing so, they access a fully functional IT environment at oneclick via a web portal and receive software, platform, and Infrastructure as a Service at any time as required. All the data and applications are securely hosted in the cloud and do not leave this protected environment.

This means the customers’ IT departments no longer have to manually set up applications and access on PCs, laptops, or smartphones and host them on local servers. Users receive “Everything as a Service” and use IT resources and common business applications such as Office as a virtual desktop solution on their respective end device.

The linchpin of the virtual desktop infrastructure (VDI) is a central streaming platform that bundles all the applications and always makes them available in an up-to-date, secure, and fast manner. The company uses an encrypted streaming protocol to deliver data and applications to customers’ end devices. The platform is hosted in the Open Telekom Cloud, whose underlying OpenStack technology ensures a smooth connection.

### **Provisioning resources for customers and scaling them automatically**

In this way, oneclick enables its customers to set up and use virtual machines (VMs) in the Open Telekom Cloud. “To do so, we use the Open Telekom Cloud’s OpenStack API to provision resources for our customers,” says Pascal Poschenrieder, Chief Technology Officer (CTO) at oneclick. Furthermore, the company operates its streaming cluster and the majority of its own in-house platform in the Open Telekom Cloud, using the Kubernetes-based Cloud Container Engine.

Auto scaling and load balancing play a particularly important role in streaming: “We can run multiple users on one pod. If the resources are exhausted, the Kubernetes cluster automatically scales up and adds new pods,” says Poschenrieder. “Additional pods, nodes, and hardware can also be added dynamically during the operation. This allows us to set up new customers quickly and flexibly without much effort and distribute the workloads on our streaming platform in a well-balanced way.” In addition, the solution is very secure: “Although all the pods run on the same server or the same virtual machine, the data of the respective users is strictly separated.”

#### **Deployment of virtual machines via OpenStack API**

Customers of oneclick select their VMs and their operating systems on the streaming platform. “We then deploy the selected resources, such as a Windows or Ubuntu image, automatically via the OpenStack API,” explains Poschenrieder. “All the application data remains in the virtual machine and thus in the cloud. The VM only receives the user’s mouse and keyboard input. The streaming platform works similarly to Netflix, based on the terminal server principle.” This is where one server serves multiple clients. To deploy a client VM, it’s also necessary to create a network, assign an IP address to it, and define security groups and firewall rules. For all these tasks, oneclick uses the OpenStack API of the Open Telekom Cloud.

#### **Open source standard simplifies code reuse**

According to oneclick’s CTO, one of the biggest advantages of OpenStack is the openness of the source: “Since OpenStack is an open standard, we can easily integrate other OpenStack-based cloud providers. The code we programmed for the Open Telekom Cloud can be reused with minimal adjustments.” Furthermore, “Since the standard is very well documented, OpenStack resources can basically be integrated very quickly into our own products, as has been shown with our own platform.”

Last but not least, the fact that the Open Telekom Cloud comes from the German OpenStack provider T-Systems plays a particularly important role for oneclick’s German customers: “Telekom enjoys a high level of trust among the users of our VDI offerings. The name stands for the fact that data and applications are subject to European data protection law and are processed and stored securely in accordance with the GDPR,” says Pascal Poschenrieder. Meanwhile, oneclick is part of the Open Telekom Cloud’s “Circle” partner program and the VDI solution is recommended to customers as a workspace offering.





# 10. Summary and outlook

Open source has become an important decision criterion for companies. The opportunity to avoid becoming dependent on one provider increases the attractiveness of open source software such as OpenStack. This is because, unlike offerings such as AWS, Azure, and Google Cloud, which are built on proprietary software, a cloud based on OpenStack uses standardized cloud software, which makes it easy to switch to another OpenStack-based cloud at any time.

In addition, OpenStack users have the choice of setting up private cloud instances and either managing them themselves or having them managed by a service provider in compliance with data protection regulations. Current market figures show that open source software such as OpenStack is on a steady growth path, similar to cloud computing.

However, open source is not usually synonymous with free. For the software to function reliably and securely, regular maintenance and updates are required – as with all software. Therefore, companies should consider using a service provider to operate a cloud based on OpenStack. This service provider should have trained and specialist personnel. At the Open Telekom Cloud, for example, dozens of experts ensure the smooth operation of the OpenStack infrastructure and the tool ecosystem.

The OpenStack community is constantly further developing its software platform and is broadening the view of open infrastructure. This is also expressed in the renaming of the OpenStack Foundation as the Open Infrastructure Foundation: Future-proof solutions focus on open source software and the integration of the most diverse tools and systems from the growing open source family. Numerous implementations at companies and organizations in all industries and of all sizes show that OpenStack is an equally effective and evolvable tool for controlling and managing cloud landscapes.

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