WHITE PAPER
OPEN TELEKOM CLOUD

The European IAAS option

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EXECUTIVE SUMMARY

Cloud computing is no longer the bold leap it once was. Once derided as a mere gimmick, its immense potential is now widely recognized. And it has come of age at the breakneck speed typical of the digital era. The cloud debate has likewise matured, now focusing on concrete ways to exploit the model to enhance business, on the technical nuts and bolts of implementation, and on cloud strategies – in Europe as elsewhere.

There are currently four main items on the cloud-computing agenda. **Security concerns** stubbornly persist as the chief roadblock to adoption. But security is a whole potpourri of issues. They include not only technical parameters or the subjective belief on the part of IT decision makers that they have limited influence. A more pertinent question relates to the consequences of compliance requirements such as data privacy. Against this background, European enterprises are demanding contracts with cloud service providers that are subject to national law and to local and European data-protection requirements.

In second place is the need for **user-friendly administration**. Experience has shown that many cloud-management tasks are left to users, who need the right skills to handle complex and unwieldy tool environments with confidence. Providers frequently hand responsibility for operating cloud-related customer service to the user organizations themselves. The same applies to technical and process-related integration issues. To a large extent, the cloud is still a do-it-yourself toolkit.

Third, the illusion that **cloud computing is always less expensive** has been replaced by greater realism. Lack of transparency and a raft of paid-for additional services – particularly network resources – make a holistic approach to cost essential.

Last, cloud customers are increasingly aware of the risk of vendor lock-in should they opt for a proprietary platform.

This is the backdrop to Deutsche Telekom's launch of the Open Telekom Cloud for the European market. It is a public IaaS from a German provider, with built-in compliance. Based on the OpenStack standard, it is easy to use and competitively priced. This white paper describes the general situation vis-à-vis public clouds, with a focus on infrastructure as a service. It offers insight into the Open Telekom Cloud's architecture, and outlines a number of use cases.

SETTING COURSE FOR DIGITIZATION

Digitization evokes a wide spectrum of reactions, from overwhelmingly positive to cautious and fearful. What is clear is that no business can afford to ignore it. The trend – and its consequences – are now firmly on the agenda for executives repositioning their organizations to meet tomorrow's challenges. If half of analysts' predictions come true, society is on the brink of far-reaching change that will transform our world and rewrite the business rule book.

DIGITIZATION: ADDED VALUE FOR EUROPE

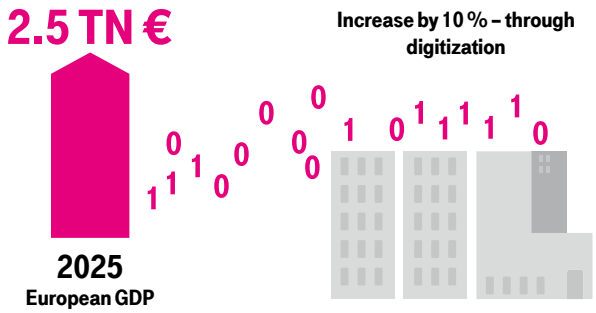

Fig. 1. Source: McKinsey

There are many aspects to digitization – both business and technical. Business aspects include data analysis that gives deeper insight into markets and customers – for better decision-making, an improved customer experience and buyer journeys, and leaner, more efficient business processes. Technical effects include greater connectivity through mobile devices and the Universe of Things, and rising data volumes and data traffic. Overall, businesses will gain ever greater customer intimacy, and time-to-market will separate success from failure as never before.

Critical factors will not only include network resources, but also compute and storage capacity. And these must be affordable, reliable and elastic. In other words, digitization cannot be achieved without cloud computing.

THE RAPID ADVANCE OF CLOUD COMPUTING

Cloud computing is clearly gaining traction, driven by trends such as the Internet of Things, artificial intelligence, enterprise mobility, and collaboration. It forms the basis for new business models and will gradually replace existing sourcing/provisioning models.

To date, businesses have generally preferred private clouds. But recent surveys indicate a move towards hybrid and public clouds – in Europe and elsewhere. In February 2017, Gartner and IDC published their latest forecasts for the public cloud market. IDC expects global spending on public-cloud services and infrastructure to reach 122.5 billion US dollars by the end of 2017. Over the 2015-2020 forecast period, total public cloud spending will experience a compound annual growth rate in excess of 20 percent. According to Gartner, the market for public-cloud services will grow by 18 percent to 246.8 trillion US dollars in 2017. Although their figures vary, there is a consensus among analysts that demand will rise for public-cloud services as a means of turning business vision into reality. [1, 2, 3, 4, 5, 6, 7]

The various cloud-computing service models – infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) are associated with distinct use cases and implementation scenarios, and target differing customer groups. IaaS is cloud computing in its original form: demand-driven provisioning of raw compute and storage capacity. Resources are charged on a pay-as-you-use basis, enabling users to try out new (digital or digitally-assisted) business models quickly, without investment risk. In this respect, the cloud can lay the foundations for future business.

Easy to implement and use, SaaS accounts for the lion's share of the cloud market, although the markets for PaaS and IaaS are also sizeable: IDC expects the global public-cloud computing market to be worth 127.5 billion US dollars by 2018, with SaaS accounting for 82.7 billion and IaaS, 24.6 billion. Another, indirect, indicator of cloud growth is global cloud IP traffic, set to more than quadruple from 2.1 to 8.6 zettabytes (1 billion terabytes) per annum by 2019.

There are two main target groups for infrastructure-only services, which are particularly popular in the IT industry: strategic decision-makers such as IT directors and CIOs who are adding cloud computing to their sourcing mix, and developers/testers who create the applications. IaaS use cases do not depend on company size, but on the skills of those who manage cloud services. Other, more specific IaaS target groups are independent software vendors (ISVs), SaaS providers and systems integrators who tap into IaaS resources to create customer-specific solutions.

IOT – A CASE IN POINT

A key driver of demand for public clouds is the Internet of Things. Public clouds are highly suitable for managing the corresponding devices and securing them against vulnerabilities, and also for analyzing the huge volumes of data generated by IoT. As the Internet of Things grows, so, too, does the cloud. McKinsey, for example, estimates that the global IoT could be worth as much as 11 trillion US dollars a year by 2025. In early 2017, Gartner predicted that there would be 8.4 billion "connected things" in 2017, up 31 percent over 2016, and some 20.4 billion by 2020.

[1] Internet der Dinge kann 2025 weltweit bis zu 11 Billionen Dollar Mehrwert schaffen, EnterpriseTech, McKinsey, 2017 (German only)
[2] Gartner Says 8.4 Billion Connected „Things" Will Be in Use in 2017, Up 31 Percent From 2016, Gartner, 2017
[3] Predictions 2017: Security And Skills Will Temper Growth Of IoT, Forrester, 2016
[4] Internet Of Things (IoT): 2017 Predictions From Forrester, Forbes, 2016
[5] Gartner Says Worldwide Public Cloud Services Market to Grow 18 Percent in 2017, Gartner, 2017
[6] Worldwide Public Cloud Services Spending Forecast to Reach $122.5 Billion in 2017, According to IDC, IDC, 2017
[7] Der Public-Cloud-Markt wächst bis 2020 weiter zweistellig, Computerwoche, 2017 (German only)

RESERVATIONS CONCERNING CLOUD ADOPTION

Irrespective of region and national legislative framework, security – in all its forms – is a key concern. In an Intel survey of 2,000 IT professionals from various countries, 49 percent of respondents reported that a lack of in-house cybersecurity skills had slowed adoption or usage of cloud services. Only 15 percent stated that they did not have a skills shortage.[8] That means cloud platforms are not regarded as inherently vulnerable; insufficient in-house security expertise is the key concern.

Most providers offer a high level of technical security. However, European businesses still face unresolved questions relating to compliance. Within Europe, 58 percent of respondents regard compliance with national data-protection requirements as mission-critical. Second in importance were user/provider agreements, with 54.7 percent of companies insisting that they be concluded in accordance with national legislation.

The EU-US Privacy Shield – a new legal framework for data exchange – has been in effect since August 1, 2016. But it continues to face criticism, and as a result the recent European Commission adequacy ruling may be overturned by the European Court of Justice. Furthermore, recent developments in the USA[9] suggest that data protection, particularly for European-based users, may be weakened. By contrast, the EU's data protection reform package, scheduled to come into force in 2018, will introduce consistently robust data-privacy legislation, on a par with Germany's.[10]

Providers are therefore failing to fulfill user needs and expectations. According to a survey by 451 Research, US players dominate the market for public IaaS. Amazon Web Services, followed by Microsoft Azure, Rackspace and Google Cloud Platform, are the key offerings. Gartner has also identified a US-dominated IaaS oligopoly – a trio comprising innovation and market leaders Amazon, Microsoft and Google.

At the same time, close to 70 percent of European companies can envisage using IaaS from the public cloud, at least in theory. Public clouds are an attractive option for two main reasons: rapid provisioning of resources without technical or organizational preconditions, and pay-per-use pricing.

A HOST OF USE CASES

Putting aside the security and compliance debate, IaaS has a host of potential use cases, especially in B2B and B2C contexts. Solutions fall into three categories, subdivided by target users:

1. Infrastructure services such as virtual data centers and application hosting are primarily attractive to IT professionals responsible for data centers, while file sharing and backups increasingly address heads of user departments, too.
2. Developer-centric services include testing and development, mobile apps, the Internet of Things and Big Data/business analytics.
3. In the case of customer-centric services, IaaS resources function in the background. They are not visible to users as services per se, but enable the operation of websites and portals and are deployed for e-commerce or digital marketing. This category also includes media and content-related use cases.

AN IT SECURITY USE CASE

Dynamic IT resources are ideal for short-term or temporary usage scenarios. Koramis, a provider of IT security services for process control, automation, and industrial software, uses public-cloud resources for its projects. Based in western Germany, Koramis finds and resolves vulnerabilities in IT systems. Customers include chemical plants, mass transit operators and smart factories. Infrastructures or new software products, such as home automation solutions, are checked for potential security weaknesses using laboratory simulations.

Koramis leverages elastic IT resources to model customer systems in the cloud. There is no need to procure hardware; the tests can be run concurrently, allowing analysis to be accelerated by employing additional virtual servers. Tasks that previously took days or even weeks can now be completed in minutes. Koramis' baseline resources comprise 16 virtual servers and four terabytes of storage. In the course of a project, up to 250 virtual servers may be required on a temporary basis. Additional resources can be provisioned from a cloud within minutes. Koramis also leverages this provisioning method for its training offerings. Previously, its instructors arrived at the customer site with a truckload of hardware. Now, all they need is a broadband Internet connection. Business-critical data is processed within a German cloud – a key criterion for Koramis customers, who are unwilling to use US-based clouds.

[8] New Intel Security Cloud Report Reveals IT Departments Find It Hard to Keep the Cloud Safe, Intel, 2017
[9] Trump has officially ended federal online privacy rules, Recode, 2017
[10] EU-Datenschutz-Grundverordnung: Das sind die Neuerungen, Astrid Ackermann, 2016 (German only)

GENERAL SCENARIOS FOR IAAS DEPLOYMENT

TOP USE CASES FOR IAAS SERVICES AND PLATFORMS

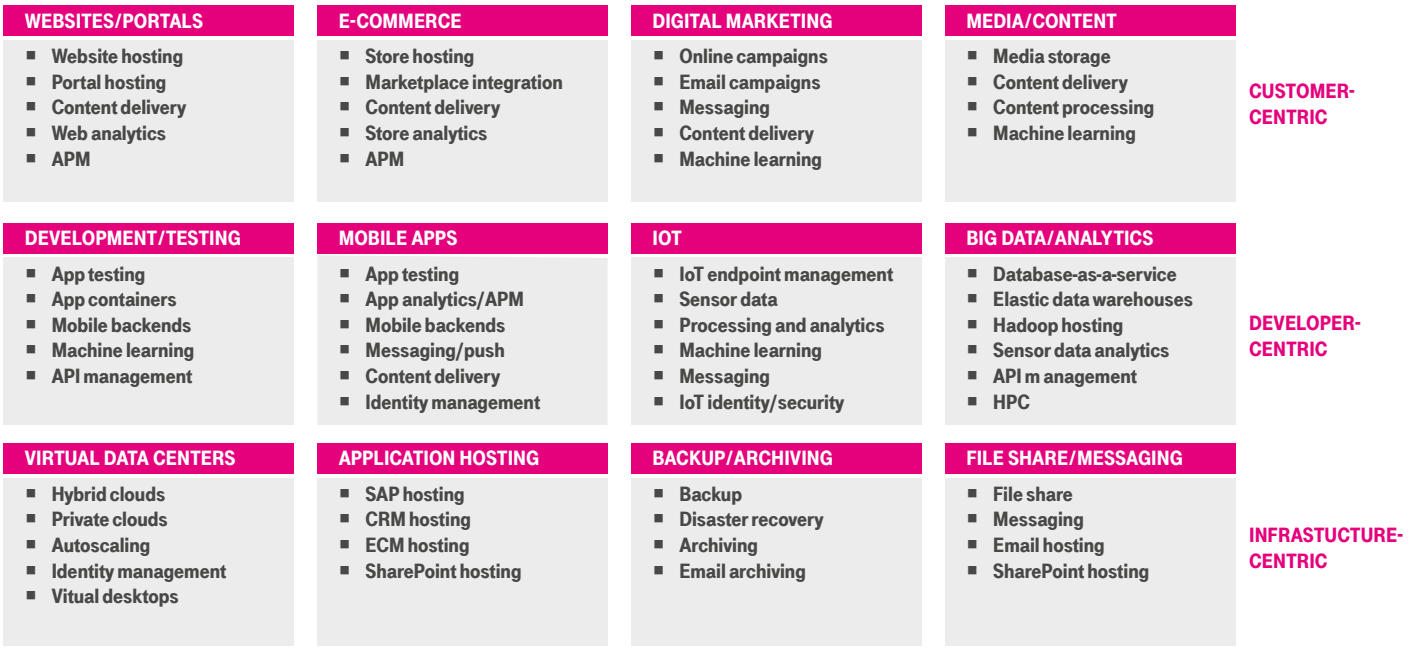

Fig. 2. Source: Crisp Research

FURTHER IAAS DEPLOYMENT CHALLENGES

In addition to the security and compliance issues mentioned above, user organizations must overcome other challenges before they can truly benefit from public IaaS. For example, the leading IaaS providers focus on offering standard services. The infrastructure resources are complemented by self-service management services (which can give rise to additional, unexpected costs). But no advice on implementation is available, nor do providers offer any indication of the network traffic volumes required for IaaS (a further significant cost factor).

Moreover, the main providers do not offer the integration of new services into existing IT environments, or the migration of existing workloads. As a result, projects of this kind call for the assistance of third parties with the right expertise. Another option would be for customers to develop the corresponding skills in-house.

However, few companies possess the knowledge required to augment their legacy IT infrastructures with a simple IaaS option. This means introducing IaaS is a major undertaking – a far cry from the hoped-for new era of simplicity in IT.

Additional costs for network and management services and – more importantly – the problem of vendor lock-in, compel user organizations to make a conscious, strategic decision in favor of a single (possibly proprietary) platform. This should be the subject of extensive discussion, particularly if the provider appears likely to develop the platform in line with its own interests rather than users'. Should a user organization need to switch to a new platform, the transfer of huge amounts of data accumulated in the provider's storage systems will be among the biggest associated expenses.

OPENSTACK

Technological dependencies can be significantly reduced by choosing an open-source platform. OpenStack has become the established leader on the cloud computing market. It is already a highly proven offering and, backed by many major corporations, could well emerge as the long-awaited standard technology for the cloud.

OpenStack began as a joint project of Rackspace Hosting and NASA.[11] Today, its community numbers more than 600 companies and 55,000 individuals (as of July 2016). OpenStack is variously referred to as a cloud management framework, a cloud computing software platform, or simply as a cloud operating system. Openstack.org describes its product as "software that controls large pools of compute, storage and network resources ... managed through a dashboard or via the OpenStack API".[12]

The first version, Austin, was launched in 2010, while the latest, Ocata, was released in February 2017. OpenStack comprises a range of components that virtualize compute resources, provision storage, and organize these into virtual networks. Another set of components provides administration functionality for users. The open-source software supports various hypervisors.[13] OpenStack is a low-cost alternative to established virtualization and cloud-management methods based on licensed software. Analysts maintain that, despite costs for maintenance agreements and software-update projects, open-source solutions – particularly in cloud computing – are less expensive than proprietary solutions.

OpenStack boasts one of the fastest-growing open source communities worldwide. The software can be used to create both public and private clouds, which facilitates hybrid strategies, too.

Analysts expect **OpenStack will gain additional traction** when cloud platform providers launch their own distributions. These are likely to offer additional management functionality that compensates for the lack of skills within user organizations.[14]

OPENSTACK COMPONENTS

OpenStack consists of a library of modules that perform various cloud deployment and management tasks. OpenStack clouds can differ as to which of the standard modules are deployed and which are replaced by alternatives. This is often the case with the Neutron networking component. Certain core modules are mandatory for all OpenStack installations, however. All components work with service APIs based on standard REST interfaces.

[11] Openstack: Viele brauchen es, keiner versteht es - wir erklären es, Martin Gerhard Loschwitz, 2015 (German only)
[12] www.openstack.org
[13] OpenStack, Wikipedia.org
[14] OpenStack im Unternehmenseinsatz, Crisp Research, 2014 (German only)

Nova is OpenStack's core component. It manages and automates computing resources and deploys virtual machines. However, Nova depends on a virtualization technology. It interoperates with the following hypervisors: KVM, Xen, VMware, Hyper-V and Linux LXC. Nova supports horizontal scaling on standard hardware. This makes it simple to integrate computing resources into existing systems.

Glance supports the management of virtual machine images. These are installation packages comprising operating system and application software that accelerate the implementation of applications in a cloud environment. Glance can store, retrieve and re-install images on servers. Only Glance can add, delete, share and duplicate images. It can also be employed to implement backups. Stored images can be used as templates.

Cinder handles block storage, providing corresponding storage volumes and attaching them to, or detaching them from, server instances. Cinder can provide persistent storage from diverse sources, both local Linux storage and a wide array of storage platforms.

Swift is a scalable object storage system. The storage clusters it manages can scale horizontally, simply by the addition of new servers. In contrast to block storage, data in object storage is distributed across multiple storage media.

Neutron manages networks and IP addresses. It offers users a range of network models; a popular option is VLANs that segregate the virtual machines. Neutron also gives users real self-service functionality – even over their network configurations.

Keystone is OpenStack's central user administration system. It supports authentication and multiple authorization methods. For example, it is compatible with existing directory services such as LDAP.

Other modules add security functionality (Barbican), billing (Ceilometer), orchestration (Heat), support for Hadoop (Sahara), database services (Trove), dashboards (Horizon), bare-metal provisioning (Ironic), cloud messaging (Zaqar) and a file-share service (Manila).

Heat is OpenStack's module for orchestration of cloud infrastructures. Resource templates enable the generation of code for task automation based on dialogs. The Mitaka version released in April 2016 gives OpenStack users the ability to add new operating-system components via plug-ins during ongoing operations (with no downtime). Mitaka has improved the stability and adaptability of IT environments on OpenStack – especially large-scale environments.

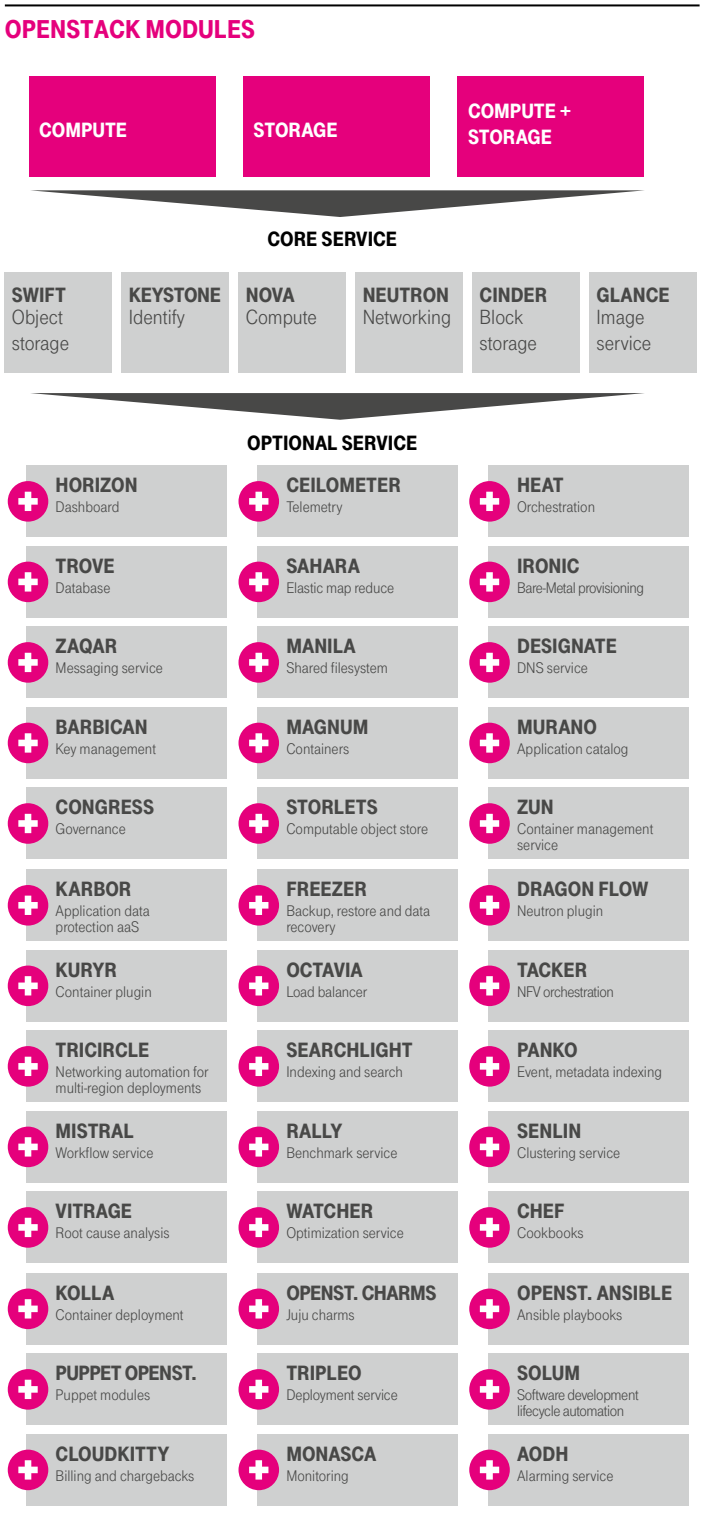

Fig. 3. Source: Openstack

OPEN TELEKOM CLOUD

TECHNICAL INFRASTRUCTURE

Deutsche Telekom launched a new public cloud service in March 2016, initially focusing on the European market. Based on OpenStack, the Open Telekom Cloud enables user organizations to avoid vendor lock-in. It also meets legal requirements for IT operations, e.g. data protection and other compliance issues.

T-Systems operates the Open Telekom Cloud in two availability zones (AZ) at data centers in Magdeburg and Biere. These are twin-core, tier 3+ facilities located some 25 kilometers apart. They are connected via a low-latency, high-speed network, and therefore meet all criteria for fail-safe operations. T-Systems guarantees 99.95 percent availability for its IaaS services.

At the data centers, T-Systems maintains pools of commodity servers with Intel x86 architectures. Compute capacity for users' virtual machines is provisioned automatically. SATA, SAS or SSD block storage is used in line with specific I/O rate requirements. Object storage is available as an alternative. The underlying network uses vSwitches, eliminating the risk of bottlenecks arising in the IP fabric. T-Systems provides users with first- and second-level support. Huawei offers third-level support by phone.

T-Systems holds comprehensive certifications validating the correct operation of the infrastructure platform, including ISO 27001 and ESARIS (Enterprise Security for Reliable ICT Services). Moreover, the provider has obtained cloud-specific certifications such as CSA STAR level 2 Gold, TÜV Trusted Cloud Service, ISO 27017 and 27018. The Trusted Cloud Initiative (launched by the German Federal Ministry of Economic Affairs and Energy) lists T-Systems as a Trusted Cloud Provider.

OPEN TELEKOM CLOUD

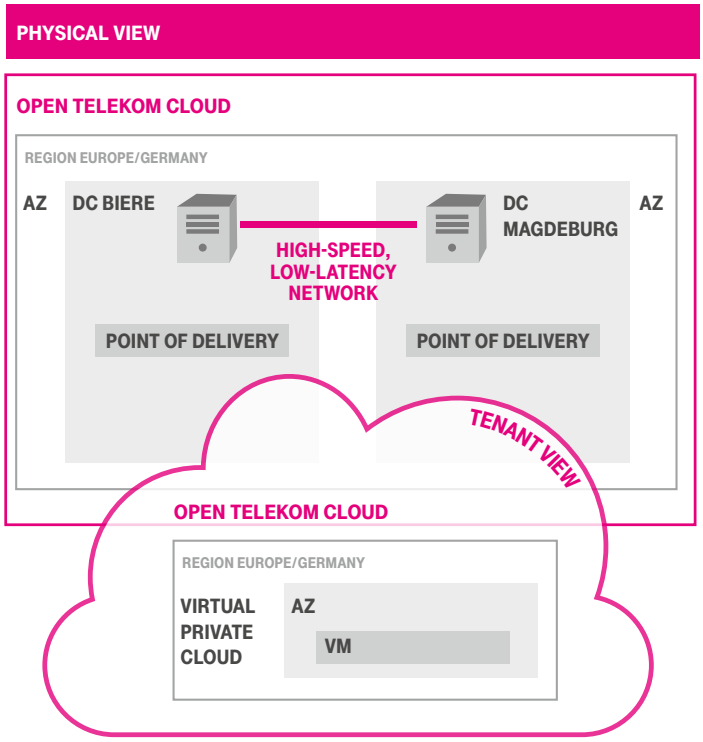

Fig. 4

PORTFOLIO

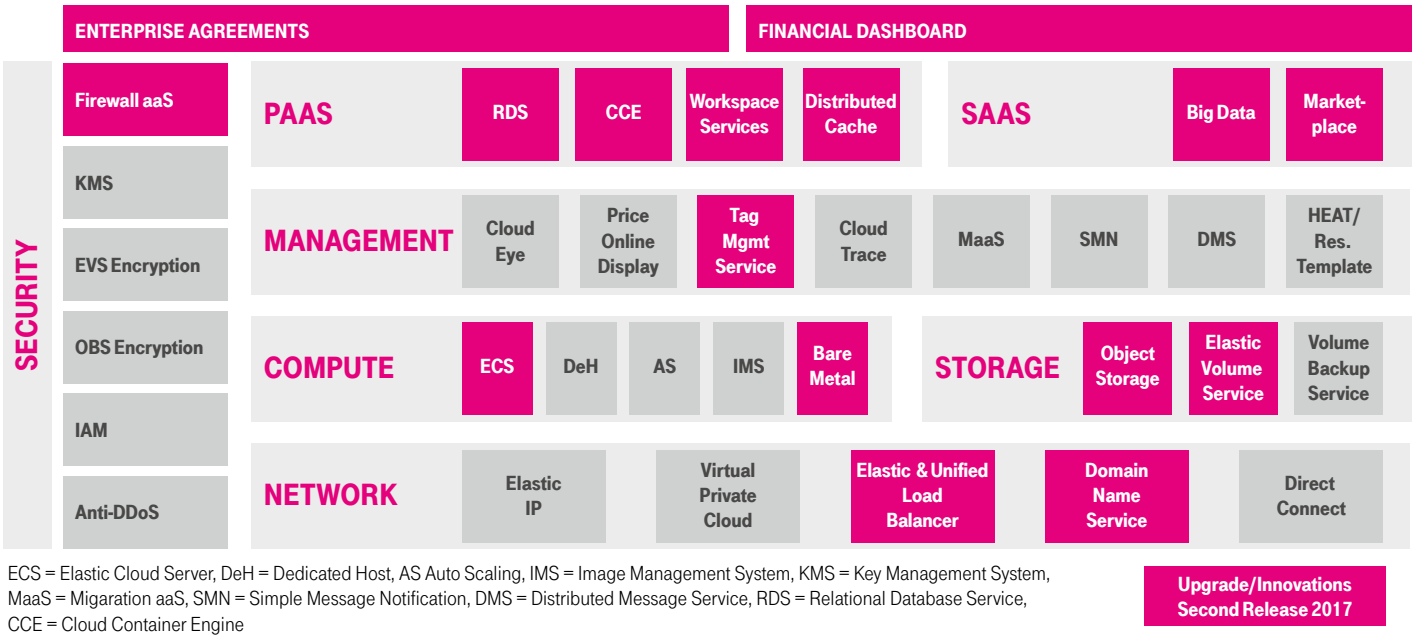

Fig. 5.

NETWORK SERVICES

Network-level services comprise elastic IP service, virtual private clouds (VPC) and elastic load balancing. They are deployed to segregate resources for multiple users, and as the basis for automatic scaling. The VPC service creates a separate section of the Open Telekom Cloud that is under the respective user's exclusive control. The Elastic IP Service provides the user with a public IP address for accessing this virtual private cloud. This also makes it possible to access Open Telekom Cloud resources via the public Internet. An IPSec-based VPN gateway is available for connecting a corporate network to the cloud platform. Network connections with higher performance can be implemented via DirectConnect. A domain name service simplifies the process of adding Open Telekom Cloud resources to an existing in-house IT environment.

COMPUTING SERVICES

The role of computing services is to provision virtual servers. Users can choose between 23 basic flavors, each with a defined vCPU-to-RAM ratio for conventional deployment scenarios. In addition, the Open Telekom Cloud provides 37 advanced flavors. These are suitable for special purposes and more specialized requirements (see below). Flavors are packages consisting of virtual CPUs and virtual RAM. The following flavor classes are available:

- **General Purpose (1:4)**
- **Memory optimized (1:8)**
- **Compute I (1:1)**
- **Compute II (1:2)**
- **High performance** – for applications that need extremely high processing power – including InfiniBand
- **Graphical processing unit optimized** – for applications requiring a GPU (cryptography, graphics processing, CAD applications)
- **Disk-intensive** – with a local hard drive for big-data applications
- **Large Memory** –for applications with significant main-memory requirements

Computing servers with 1 to 36 vCPUs are available, with 1 to 940 GB RAM. Users can currently choose from seven groups of operating systems: Open Linux (CentOS, Ubuntu, openSUSE), Oracle Linux, SUSE, Red Hat, Debian, Fedora, or Windows.

OVERVIEW OF AVAILABLE FLAVORS

	RAM [GB]			
VCPU	Comp I	Comp II	Gen Purpose	Mem Opt
1	1	2	4	8
2	2	4	8	16
4	4	8	16	32
8	8	16	32	64
16	16	32	64	128
32	32	64	128	-

	RAM [GB] + ADDITIONAL RESOURCES				
VCPU	High perform	GPU	Workspace	Disk-intensive	Large Memory
2	4,8,16	-	4	-	-
4	8,16,32	8 + vGPU	8 (+ 1 vGPU)*	32 + 5,4TB	128
6	-	-	16	-	-
8	16, 32, 64	16 + vGPU 64 + GPU (pass-through)	16 + vGPU	64 + 10,8TB	128/256
12	128**, 256**	-	-	-	256
16	32, 128, 256	-	-	128 + 21,6TB	470
18	-	-	-	-	445
32	64, 128, 256	-	-	-	940
36	-	-	-	256 + 43,2TB	890

* optional ** with 100 G InfiniBand EDR

Fig. 6.

In addition to this range of flavors, the Open Telekom Cloud offers a dedicated host that can be rented by the hour. There are three hosts available, each featuring two sockets with 12 cores, leveraging various processor classes (Intel® Xeon® E5-2658A v3 and Intel® Xeon® E5-2690 v3) plus memory (264 GB/328 GB). These hosts can be leveraged to run virtual machines on the basis of the available flavors. In addition, bare metal resources have been offered since June 2017, enabling users to create their own virtualization layer. This also allows the definition of user-specific flavor sizes. Above all, bare-metal resources deliver improved speed for highly processor-intensive applications.

Computing services can be combined with other services, such as auto scaling (scaling of resources in line with workload), or an image service. Images are preconfigured operating systems (including drivers), with optional applications. The Open Telekom Cloud provides preconfigured system images, but user-defined ones can also be created and stored for rapid access. For this purpose, all flavors are allocated fixed SAS, SATA or SSD block storage.

STORAGE SERVICES

The Open Telekom Cloud offers two basic storage solutions: block and object storage. Object-based data storage is accessible via the Internet using HTTP or HTTPS protocols, and is independent of specific compute resources. Data is not physically stored in a single contiguous block. Free storage capacity is used in line with requirements. Object storage is an affordable option for long-term retention of large data volumes. It offers 99.999999999 percent data durability. Object storage can accommodate files of up to 50 TB in size. Object storage is available in three classes, in accordance with data usage needs: cold, warm, and standard. Cold OBS is suitable for data that needs to be saved but is only seldom processed (typically once a year). This option does not support real-time access. There is a choice of three classes of data recovery/extraction. Warm storage offers the same specifications as standard OBS, but is intended for data that is accessed approximately once monthly. Standard OBS offers rapid access to data that needs to be processed frequently and directly, for example by means of big-data tools. In other words, users can choose the storage method that best suits their data usage.

It comes complete with the native S3 API, a web management dashboard, a cloud storage service web client, and a software development kit for the user organization.

Block storage is persistent storage attached to the compute resources as a virtual drive. Unlike conventional hard disk arrays, this storage service stores identical copies on multiple storage nodes to retain the data with a durability of 99.99995 percent. Between 40 GB and 32 TB of block storage can be selected, and up to 10 virtual drives can be attached to one compute instance.

A volume backup service offers additional protection for block storage resources. Data on local systems and storage devices is backed up by the snapshot method, enabling rapid restoration. Block storage comprises separate pools for the various classes (SSD, SATA and SAS).

CLOUD MANAGEMENT

Cloud resources are either accessed via the cloud dashboard or directly, by means of the APIs provided (native OpenStack or other, special-purpose APIs). Customers can employ a dashboard to manage compute and storage resources, and images. A cloud monitor service ensures transparency, giving users information on active resources and consumption levels at any time. If myWorkspace is implemented, users are assigned administrator accounts for managing their resources. Further users within a given organizational unit are created via this type of account. Subsequently, an identification and authentication service provides secure sign-in and identification of these users. Accounts also support the definition of quotas to limit resource usage to a specified maximum. This helps organizations to avoid exceeding budget thresholds. Moreover, when the virtual machines, etc. are activated, the price is displayed on-screen for complete cost transparency.

The cloud trace function allows users to automatically generate log files that record all changes to resources. This is especially useful for auditing purposes. There is a distributed messaging service (DMS) and a simple message notification (SMN) service, both based on API calls. Furthermore, the SMN function can be employed to send SMS text messages or emails to external contacts. Migration-as-a -service (MaaS) and HEAT/ resource templates are two Open Telekom Cloud management services that simplify data transfer and resource orchestration.

SECURITY SERVICES

The Open Telekom Cloud optionally provides encryption for block and object storage. In addition, a central system is in place for the management of Open Telekom Cloud public access keys.

There is also an **anti-DDoS** security service that detects distributed denial of service attacks aimed at crippling web addresses on the public Internet. It also actively responds to such attacks, safeguarding the availability of applications running in a cloud. Anti-DDoS protects the public IP address, ensuring that applications operated on the Open Telekom Cloud are not affected by criminal activities designed to overload servers – such as challenge collapsar attacks, UDP and SYN flooding. The service performs security filtering at the firewall on data traffic over public IP addresses.

PLATFORM SERVICES

The cloud container engine (CCE) enables the deployment of Docker containers for the transfer and roll-out of IT services. A relational database service (RDS) that supports mySQL, PostgreSQL and Microsoft SQL Server is also available. RDS provides powerful monitoring functionality, delivering visibility into the status of VMs and comprehensive performance reports for data management purposes. Standby databases can be created (in addition to the primary database) to ensure high availability. Up to five read-only replicas can be added for each database cluster, enabling rapid access. Redis is a distributed cache service, including in-memory computing. Open Telekom Cloud's workspace service provides a number of flavors (including integrated vGPU) in the form of virtual desktop infrastructures.

EXTENDED SCOPE OF SERVICES: BITNAMI AND HYBRID CLOUDS

The cloud computing model has existed in principle for more than a decade. But in this time, expectations have changed. There is still interest in plain-vanilla on-demand virtual machines and storage . However, users now want additional services that ensure greater convenience, and suites that offer not just IaaS but also PaaS and SaaS. Cloud vendors are therefore continuing to evolve their offerings. Bitnami supports a broad range of PaaS and SaaS services. In fact, Bitnami offers a dedicated launch pad for the Open Telekom Cloud, suitable for more than 150 open-source services, such as Joomla, Wordpress, Maria DB, etc. And the introduction of the third-party marketplace in 2017 will further extend the variety of services available.

One of the hottest topics among users in 2017 has been hybrid clouds and the management of multi-clouds.[15] Multi-cloud environments consist of multiple autonomous cloud solutions, each operating in isolation for a clearly delineated functional scope. Hybrid clouds, by contrast, entail the integration of diverse IT components with the aim of modelling an entire or partial business process. This has to take account of a variety of cloud types (private, public, community), and also more traditional IT installations. OpenStack facilitates this task. In the course of 2017, a hybrid Open Telekom Cloud model will be introduced that allows users to implement their own private installations alongside the public Open Telekom Cloud.

USER SUPPORT IN ADDITION TO SELF-SERVICES

On-demand infrastructure services are generally only provisioned and managed via low-cost online channels. User self-services play a significant role in these delivery models. In addition to the usual self-service functions, the Open Telekom Cloud offers consulting services. A consulting website directs experts and beginners to the service packages that best meet the needs of their use cases. Other basic services, such as the hotline, are included in the package prices.

Companies who wish to incorporate the Open Telekom Cloud into their standard **sourcing mix** – rather than using it **for specific purposes** – can take advantage of in-depth consultations with enterprise architects. T-Systems also offers project-specific transformation and migration services through its systems integration organization.

Once a customer has decided to use Open Telekom Cloud resources, Deutsche Telekom provides a **central portal to all public cloud services**, via cloud.telekom.de. Users simply log onto this site to order, deploy, and manage the resources they need.

[15] New 2017 Cloud Trends and Stats: RightScale State of the Cloud Report, Rightscale, 2017

USE CASES

A key strength of open platforms is that they enable the multi-cloud or hybrid-cloud scenarios that businesses need – scenarios that will shape the cloud landscape in the years to come. At the same time, enterprises must always weigh up the extent to which existing applications can or should be migrated to the cloud.

MIGRATING TO THE CLOUD

Typically, corporate IT environments include a wide range of legacy software that has been employed to model core processes, with very little modification, for a great many years. This can include standardized ERP solutions, office packages, more recent Web applications or even cloud-native systems.

Their **suitability for cloud migration** will vary considerably, depending upon generation and architecture. However, migration does not necessarily mean that the application will be transferred to a cloud-native architecture. The simplest approach is to lift and shift from a dedicated platform to a dynamic one – primarily to make savings.

Transferring cloud-native applications between multiple infrastructure clouds is the most straightforward task of all – as they have been designed from the outset to run on dynamic infrastructures. In other words, there are no static relationships – and all instructions required are already within the application itself.

Migration tools can be deployed to move applications between clouds, e.g. to cut costs, to secure better service levels or achieve greater security. A typical migration scenario comprises the transfer of an application from the development to the production platform, with Docker containers emerging as the standard method of doing so. The Open Telekom Cloud achieves this by means of the Cloud Container Engine, based on Docker containers in conjunction with Kubernetes. Open-standard clouds simplify transfer still further. Proprietary clouds, by contrast, often necessitate additional steps. And if applications use provider-specific services, transfer will not be possible. Nevertheless, the migration of this type of software is associated with far less effort and expense than is the case for legacy applications – which require resolution of issues related to DevOps application management, availability and horizontal scalability. Applications may need to be completely redesigned before they can be ported to a cloud platform.

The most obvious scenario for cloud-based application operations is Web applications or SaaS. Creatieve Koppen, an innovation management agency based in Rotterdam, The Netherlands, operates an online application that supports the development of new business ideas within teams. Application load fluctuates greatly in line with demand. Operation in a public cloud allows the agency to auto-scale IT resources to ensure a consistently positive user experience.

Octopus AG, a Swiss startup, operates an SaaS offering for the management of Microsoft licenses on the Open Telekom Cloud. Service providers can harness the software to automatically generate reports on the number of licenses being used, and how they are being used. The solution enables efficient software asset management, and requires high scalability.

But public clouds can also, contrary to widespread perceptions and prejudices, support enterprise-class applications. For example, the Open Telekom Cloud can host SAP systems for sandboxing, testing or training purposes. The provisioning of infrastructure resources from the cloud is also ideal for large, memory-hungry systems, such as SAP HANA, that are being used for short-term tasks, such as training. Traditional delivery models simply cannot match the cloud in terms of speed of deployment and cost/benefit.

Public cloud resources are also ideal for archiving entire SAP systems (or other established business systems). JIVS on the Open Telekom Cloud makes it possible to "mothball" data and corresponding applications. This makes sense, for example, in banking when data needs to be retained within context to answer questions posed by regulatory bodies. Maintaining an operational system that has no direct business benefit is prohibitively expensive, but the data needs to be stored within its framework of reference to be useful. Transfer of the entire system to a public cloud is a way of resolving this dilemma – and making large savings. Public cloud resources are also ideal for transferring systems to the cloud within the scope of a dedicated migration project.

MANAGE GROWING VOLUMES OF DATA WITH CLOUD STORAGE

Business process of many types already generate significant volumes of data – data that must be retained for reasons of compliance, for big data analytics, or which users simply wish to archive for their own reasons. In particular, significant data is produced by communications systems. For example, emails, although often seen as yesterday's technology, continue to be extremely popular, with 215 billion being sent in 2016 alone.[16] Then there is the data that collects on intranets and collaboration platforms – and is seldom deleted. And media industry companies, by the very nature of their business model, must archive huge amounts of data for print, video and audio.

Those are the more traditional sources. New, almost inexhaustible, generators of data include connected cars, predictive maintenance solutions, and the Internet of Things. The quantity of data is skyrocketing. It is the raw material of future business models. And it requires huge, readily-available storage capacity.

In hybrid scenarios, production systems can be operated in-house – but the data is maintained in a storage cloud that expands in line with demand, acting either as the primary repository or as back-up. The use of public clouds eliminates the need for designers and administrators to develop and manage their own storage resources – which do not, in any case, generate competitive advantage. There is also no call for regular upgrades to new hardware, or for the maintenance of corresponding in-house skills.

Aircraft manufacturers must retain engineering, design, image data and statistics for approximately 30 years after the final model in question has been decommissioned. Moreover, component documentation must be kept for at least 25 years. As a result, many terabytes of data have to be stored purely for reasons of regulatory compliance, but without any operational benefit. This data can be placed in low-cost "cold" object storage in a public cloud – reducing the load on production systems while fulfilling reporting obligations.

PUBLIC CLOUDS FOR HIGH-LOAD APPLICATIONS

There are applications that test conventional cloud environments to their limits. Examples include high-load research scenarios and big-data analytics. The particle physics research conducted by CERN, the European Organization for Nuclear Research, continues to break records when it comes to crunching huge volumes of data. And in this context, the institution was quick to recognize the potential of cloud and OpenStack technology.

CERN harnessed the Open Telekom Cloud to capture, store and analyze data generated by its physics experiments within the scope of an evaluation project for the Helix Nebula Science Cloud. In addition to 1000 virtual machines and 500 TB of storage, the network infrastructure plays a pivotal role. CERN analyzes huge volumes of data by means of a hybrid-cloud model. The Open Telekom Cloud is employed to supplement in-house resources in order to better manage peak loads. Moreover, the scientists gain greater visibility into resource utilization. The partner selection process for the implementation of the European science community cloud is still ongoing. A decision on the two external public cloud providers will be announced in 2018.

Other high-load scenarios include simulation tasks in the automotive industry and the up-and-coming discipline of bio-informatics. The latter faces a systemic challenge: the performance of genetic analysis sequencers is outstripping the pace at which IT resources can be made available. Moving to the cloud offers a way forward.

[16] E-Mail Statistics Report 2016 - 2020, The Radicati Group, 2016

OUTLOOK

IaaS services provisioned from the public cloud are the future, and the foundations for this future are being laid right now. Companies that fail to embrace the digital era will be left behind. The global and European public-cloud IaaS market is growing fast, with no end in sight. And it is creating the basis for higher-quality PaaS and SaaS offerings.

Public-cloud IaaS offers user organizations simple, low-cost access to on-demand infrastructure resources for a variety of scenarios.
The Open Telekom Cloud marks Deutsche Telekom's entrée into the public cloud market. As a German-based provider, the company is subject to strict national and European legislation and governance. This could be considered a burden. But it is of advantage to Open Telekom Cloud users. Deutsche Telekom is able to offer a comprehensive service package that guarantees robust data protection – as a German provider, with German-based data centers, and European service management. As a result, companies that have, until now, displayed reticence toward public cloud services for compliance reasons, can now take the plunge with good conscience. The Open Telekom Cloud comes complete with data protection, without the user organization having to implement specific mechanisms of its own.

The offering meets the needs of companies with strict security and compliance requirements – but it also addresses price-sensitive and dynamic businesses looking for simple, low-cost and rapidly available resources – in order to develop and test new applications, explore new business ideas or to find fast and lasting answer to resource needs.

Moreover, Deutsche Telekom offers a variety of consulting options to user organizations intending to make the Open Telekom Cloud an integral part of their IT landscape in the longer term. The company has a broad systems integration skillset, encompassing cloud computing, process expertise and in-depth knowledge of multiple industries. This is exactly the support that many European customers need in order to take the leap into cloud computing.

The Open Telekom Cloud from Deutsche Telekom creates a versatile basis for digitization projects in all sectors. In addition, this IaaS creates a platform for further PaaS and Saas offerings. The Open Telekom Cloud has already established firm foundations – with the introduction of Bitnami, Rescale, Akamai and a Hadoop/MapReduce suite, in conjunction with the implementation of a marketplace for third-party applications. And to support hybrid environments, the Open Telekom Cloud plans to make resources available for private models. This will simplify the generation of hybrid clouds within burst scenarios.

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