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EXECUTIVE SUMMARY

As the digital transformation takes hold, it is becoming clear that established industry giants are not necessarily the strongest performers. Time and again, they are being outshone by more dynamic enterprises that have recognized and embraced the change early on. These disruptive players are sharpening their competitive edge with state-of-the-art ICT tools that allow them to strengthen customer relationships and provide their employees with innovative productivity tools.

For companies looking to tap into these opportunities, cloud computing has emerged as the provisioning and usage model of choice. It has become an indispensable element of the sourcing mix and continues to gain ground. However, adoption has not always been smooth, as the technology enables user departments to access services without the IT department’s knowledge or consent. As a result, multi-cloud environments are springing up in the enterprise – whether they are wanted or not.

CIOs are therefore facing a new challenge. As the complexity of the IT landscape grows and the sprawl of services spreads, IT budgets are slipping from the grasp of management – and the prospect of effective governance is becoming ever more distant.

However, there is another way. IT departments can make a conscious decision to actively support a multi-cloud strategy, positioning themselves as a true partner that supports and enables business. And they can cement their influence on in-house IT usage in the process – safeguarding security and ensuring all legal, compliance and governance requirements are met.

One promising avenue for achieving these aims is cloud services brokerage. Although the concept is relatively new, it is already emerging as a viable option for managing infrastructure as a service (IaaS) offerings, which currently account for 40 percent of the total cloud market.

By bringing together multiple providers on a single platform, brokerage solutions allow IT departments to more effectively manage access to resources. In doing so, CIOs gain greater transparency into and control over cloud usage within their organization.

Cloud broker functionality can be implemented as a service layer within the cloud. On the basis of user-defined parameters, the software evaluates a variety of IaaS offerings and recommends the best option for the task at hand. Moreover, it monitors the status of the virtual machines, keeping track of resource consumption and costs. More sophisticated solutions include ‘transformation engines’ that support seamless transfer of cloud services from one provider to another.

Cloud brokerage allows enterprises to take advantage of the individual strengths of multiple providers. What counts as a strength will depend on the usage scenario. Sometimes price might be the decisive factor; other times, it may be security. Or perhaps a service is simply the perfect fit for a specific business requirement.

Organizations developing in-house cloud broker software have remained the exception to date. But third-party providers have already brought their first brokerage offerings to market, delivering a fast-track solution to a pressing challenge. Right now the focus is on services for IaaS resources: highly standardized, they are by and large interchangeable from the user’s point of view.
A WORLD IN FLUX
Across industries, markets are being transformed at an incredible pace. This is not a new development. For years, analysts have been debating how enterprises can best meet the challenges of this new environment. At the same time, the explosion in digitization and interconnectivity has provided unparalleled opportunities for new and innovative players looking to challenge the reign of established market leaders.

USERS AND CUSTOMERS ARE TAKING THE REINS
Amazon is perhaps the most striking example of this trend. The Internet giant has entered one crowded market after another and conquered them all – first tackling book retail, then the mail-order business, and more recently expanding into the IT services sphere. Its success has come primarily at the expense of established players: major changes rarely create new markets; they simply lead to a shift in market share. In this battle for customers’ business, digital expertise has emerged as a key weapon.

Another significant development is that customers are no longer just users and consumers. Through the power of social networks, they are becoming opinion makers and trendsetters. They are eager to share their thoughts on products and brands, influencing the purchase decisions of others. Within the company, employees, too, are driving change. They expect to be able to bring the services they use on their smartphones and home computers into the office – a trend described as ‘the consumerization of IT’. It is official: the age of the user and of the customer have arrived.

THE QUEST TO GET CLOSER TO CUSTOMERS
In this changed environment, enterprises must rapidly respond to the latest trends and customer demands if they are to remain competitive. One approach is to deploy innovative collaboration concepts that accelerate internal processes while enabling a new level of interaction with customers. Another option is big data analytics, which can reveal new market insights and significantly improve the basis for decision-making.

CLOUD COMPUTING: AN ESSENTIAL INGREDIENT FOR SUCCESS
None of these developments would be possible without cloud computing. Initially dismissed by skeptics as mere hype, this delivery model has since definitively proven its worth. It has become an established sourcing option; and nobody seriously questions its value anymore.

“While the last number of years saw businesses experimenting with the technology, cloud platforms and services are now an essential element of the enterprise IT landscape.”
James Staten, Forrester, on zdnet.com

By making it possible to deploy IT resources in line with demand – without having to commit to long-term contracts – cloud computing has provided unprecedented agility and greater financial flexibility. Now, enterprises can align IT resources with their requirements, allowing them to keep pace with a dynamic environment and develop new business models.

REDEFINING THE ROLE OF CIO
CIOs are at the center of these developments. They are faced with user departments that are increasingly taking responsibility for IT into their own hands. Analysts estimate that shadow IT spend already comprises anything from 10 to an incredible 50 percent of the overall budget in some industries. This is because cloud technology makes it easy for users to decide for themselves which services they use. In fact, IT departments are consulted on these decisions in just 49 percent of companies.

Cloud computing gives greater freedom to users, and they are embracing it wholeheartedly. If CIOs opt to actively support and shape this trend, they can position themselves as true partners to the business in the long term. The cloud drives IT transformation. As a holistic process, this transformation should be managed at the highest level – and that means the CIO should be involved in all company-wide cloud strategies.
CLOUD COMPUTING: THE STATE OF PLAY

Ready availability, usage-based pricing and flexible delivery models – with benefits such as these, it is no surprise that the cloud services market is booming. PAC estimates the public and private cloud market to be worth around 100 billion euros in 2014 – and growing by approximately 20 percent annually. About 40 percent of this total is attributable to IaaS. The “aaS” shorthand is used by diverse providers to describe a multitude of service offerings. Three fundamental models have emerged (although some analysts propose further additions): infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS), with the degree of abstraction and complexity rising with the move from IaaS as the bottom tier to the top layer of SaaS.

IaaS is the ideal solution to a number of common challenges. For example, it provides users with access to resources at short notice to counter spikes in load – or supports businesses that regularly require additional capacity for short periods. Project, test or development environments are typical examples. But IaaS is also deployed in production environments where load fluctuates significantly, or to support disaster recovery solutions.

IaaS differs from other ‘aaS’ offerings in one important regard: from a technical point of view, infrastructure resources can be seen as a ‘commodity’, i.e. the service offered is practically identical from one provider to the next. This makes it easy to switch between services as required, in theory at least.

IAAS AS A COMMODITY? THE ISSUES

However, in practice, three difficulties arise:

- Unexpected problems often occur when transferring services via virtual containers.
- Although solutions may be very similar in terms of technology, they can differ significantly on the organizational level: for example, if certain types of data cannot leave certain jurisdictions. This means the location of service delivery can play a major role when selecting a provider.
- The market is highly dynamic – new providers enter, others leave; rates fluctuate wildly and pricing models vary significantly.

Keeping track of the dizzying array of offerings and providers is no easy task. In fact, it is almost impossible without some sort of automated system. But if users lose sight of the bigger picture, they miss out on one of the great benefits of cloud computing: the ability to pick and choose the best solution for their requirements.

COMMODITIZED RESOURCES THANKS TO HIGH STANDARDIZATION

For the most part, IaaS offerings are not designed for a single specific purpose. On the contrary – computing power, storage and memory resources can be deployed in a wide range of scenarios. Demand in enterprises is rising: 451 Research estimates that 22 percent of companies already access infrastructure services via the public cloud, while 17 percent are opting for delivery from virtual private clouds.
MULTI-CLOUD ENVIRONMENTS ARE HERE TO STAY

Multi-cloud environments emerge in one of three ways. In some cases, companies make a strategic decision to implement a multi-vendor approach. In other instances it happens unintentionally. Users begin deploying cloud services on their own initiative and by the time the IT department is aware of the situation, it is too late to stop it. Between these two poles is a third scenario: external cloud offerings are tolerated if not encouraged, and departments draw on diverse services for test and development purposes as requirements dictate.

There are many good reasons to deliberately opt for a multi-cloud approach. Firstly, it can minimize risk and avoid dependency on a single supplier, safeguarding against vendor lock-in or (temporary) downtime. Moreover, it allows enterprises to maximize cost advantages and pursue a best-of-breed strategy. The more ad hoc route, on the other hand, can lead to a messy patchwork of services – making end-to-end management difficult, if not impossible.

“Customers take advantage of the opportunity to choose their preferred hardware and software components, generating a need to coordinate the individual elements. The rapid development of this trend is leading to the establishment of cloud orchestration platforms.”

Ramunas Svarcas, TBR

When it comes to contractual arrangements, ‘aaS’ offerings have the advantage of being highly standardized – including with regard to their terms of use, simplifying their integration into a company’s sourcing mix.

However, any multi-cloud strategy must go hand in hand with a company-wide governance approach. This is the only way to ensure visibility into the use of cloud services and to create appropriate management structures with respect to legal, security and compliance imperatives. And of course the CIO is in the best position to ensure these requirements are met.

In light of the time-consuming administrative tasks involved in deploying a multi-cloud strategy, an automation service of some kind can be of clear benefit. A number of providers are already offering support of this nature: in the form of ‘cloud brokerage’ solutions, available as standalone components or as part of an end-to-end cloud management suite.

Analysts predict that multi-cloud scenarios will soon become the norm. However, this will increase the need for effective service orchestration and call for greater transparency.
WHAT IS CLOUD BROKERAGE?

A NEW ROLE IN THE CLOUD ECOSYSTEM

As multi-cloud approaches become the norm, an important new role has emerged: the cloud broker. The term can mean one of two things. It can refer to a provider who coordinates access to a range of cloud services – a broker in the conventional sense of a ‘go-between’. Or it can be used to describe a technical service layer that uses automation mechanisms to enable day-to-day user access to various cloud offerings. In this white paper, we will be using the term in this second sense. The technology is already at the stage where broker solutions can be effectively deployed in conjunction with IaaS resources.

Gartner’s Hype Cycle rates cloud service brokerage as a hot topic about to peak – because CIOs are facing the challenge of regaining control over the use of services from diverse providers.

“The goal of a broker is to make cloud services more specific to a company, or to integrate or aggregate services, to enhance their security, or to do anything which adds a significant layer of value.”
Darryl Plummer, Garner, on forbes.com

IAAS MARKETPLACE WITH ADDED SERVICES

The broker unites a number of elements of the cloud landscape that previously existed independently of one another. At its most basic level, it can be compared to a central portal or marketplace. However, it not only enables users to compare and purchase a range of offerings. It also manages all services running on the customer’s cloud infrastructure, and can even migrate them if required. Another important aspect is that the participants in the cloud broker ecosystem can change their role to adapt to new situations. For example, a user can become a provider – giving businesses that have invested in infrastructure the opportunity to offer their resources on the market whenever they have capacity to spare.

BASIC SERVICES

The basic services perform fundamental administrative functions for the cloud broker, including identity management and approval workflows in line with assigned user rights (on-demand self-service). Selection of resources and automatic provisioning and scaling of services deliver flexibility in a technical sense – a basic requirement of every cloud system (rapid elasticity). From a management perspective, ongoing monitoring of use (measured service) provides the basis for analysis, report generation and information on costs. For customers, this creates far-reaching transparency, while allowing them to better manage the use of their resources.

HOW IT WORKS

To perform these functions, a cloud broker usually comprises three core components: a set of basic services, a decision engine and, optionally, a transformation engine.
**CLOUD BROKER: CORE COMPONENTS**

**DEcision ENGINE**
The decision engine plays a key role, acting as the cloud broker’s ‘advisor’. Its logic brings together the provider and customer sides. It accesses the terms currently offered by the various IaaS providers and calculates the available resources. It then compares its findings with user requirements, in order to generate a proposal that is the best possible fit to the customer’s needs. In other words, it matches supply with demand for the situation at hand, before selecting the appropriate infrastructure provider.

**TRANSFORMATION ENGINE**
The transformation engine comes into play whenever a service needs to be migrated – for cost reasons, for example. It acts as the ‘logistics specialist’ of the cloud broker, ensuring seamless ‘transport’ of the services from one provider to another. The technical architecture is designed to logically separate the service descriptions from the infrastructure services. This makes it easy to move – via a virtual container – the required instructions and data to another IaaS environment that meets the defined standards. One important aspect needs to be taken into account: when the service container is migrated, so too are the applications and operating system. The use of applications and OS on the current provider’s virtual machines might be free of charge or factored into the overall price – but this is not necessarily the case for the new IaaS operator. It is therefore essential to check the terms of use of the software in advance.

**ACCESS TO CLOUD BROKERS**
Cloud broker services from external providers can be accessed over the Internet. Additional network resources are not generally provisioned for transformation; rather, existing bandwidth connections are used – between the IaaS provider and the broker, and between the broker and the user who orders the service and submits instructions to the virtual machines. Some providers also offer secure access via a VPN, ensuring a greater degree of protection for data. Users should clarify in advance the level of security they require.

Yet simply implementing robust safeguards for access to the broker is not enough to guarantee end-to-end security. To do that, it is imperative to ensure airtight protection for all connections between providers and for the activities that take place on cloud platforms.

Typical parameters for IaaS are storage, memory and computing resources, plus rates are usually calculated on this basis. Further specifications that can be defined by the user are the duration and location of service delivery.
With brokerage offerings, IT providers make good on one of the original promises of cloud computing: the ability to easily shop around for services and switch between providers as and when required.

If the cloud broker is publicly accessible, it benefits end users in the organization. But this is also to the advantage of the IT department, allowing it to act as the central manager of public and private cloud resources. IaaS providers, too, stand to gain – as they can leverage an effective sales channel operated by a third party.

**ADDED VALUE FOR END USERS**

For users, a cloud broker solution puts an end to the time-consuming hunt for the right provider and the effort entailed in combining various services or even compiling a pool of suppliers. Instead, these processes are completed with a few clicks of the mouse: users simply input their requirements and the decision engine weighs up the available offerings in real time, before identifying the best option for the task at hand.

Moreover, the decision engine automatically ensures that all legal and compliance imperatives are met. The upshot is that the user can focus on actually using the services they need – rather than wasting time painstakingly researching competing alternatives, or struggling with the nuts and bolts of administrative processes.

The cloud broker ensures it that the services meet a defined standard. A further advantage of unifying offerings in a marketplace setting is that there is no need to manage diverse access channels; rather the users can source all standardized cloud resources via a single location and can make purchases easily, flexibly and in line with their needs.

**A KEY ROLE FOR THE IN-HOUSE BROKER**

Research shows that end users view the IT department as fulfilling the central role of cloud broker in the enterprise, in the management sense of the term. So it stands to reason that IT staff, too, will benefit from an external brokerage solution. The arguments are largely the same as for end users, yet there are additional considerations – for example, the fact that end-to-end packages are available to significantly accelerate the implementation of cloud brokerage within the organization. A further advantage is that by taking the reins on this issue, the IT department positions itself as a business enabler – responding to the calls of users for greater freedom, while retaining central control over the process. Against this background, CIOs have the opportunity to become cloud pioneers, without the need to devise and implement time-consuming in-house innovation projects.

**OPPORTUNITIES FOR PROVIDERS**

Providers complete the cloud broker ecosystem. And they too stand to gain, as the creation of a standardized marketplace offers them an excellent sales platform. All relevant information can be accessed via the publicly accessible APIs. Once they meet the standard requirements, less-well-known providers can contact the broker to be added to the list. This creates a new kind of broader, more efficient sales channel that is open to all market participants. And because they will be directly compared to each other, every provider must be aware of what makes them stand out from the competition and must clearly communicate this to the decision engine. The end result is a more competitive sales environment – which is ultimately to the advantage of users, too.

It is the business side, however, that will benefit most from cloud brokerage. Because users can access cloud services more quickly and easily, they enjoy a much broader choice and scope for deployment than was the case when they were limited to a single provider. Once they can manage their own clouds, they have a better basis for planning expenditure and cutting costs. And coping with peak load scenarios becomes easier than ever before.
The Solution in Practice
T-Systems Cloud Broker

Cloud brokerage is still a relative newcomer to the IT services scene. However, its emergence is a testament to just how central cloud offerings have become to the enterprise sourcing mix. And as they continue to grow in importance, brokerage solutions are rapidly becoming a viable option for more and more companies.

Supported IaaS Providers
T-Systems Cloud Broker supports the APIs of Windows Azure, VMware’s vCloud, Eucalyptus, Amazon Web Services, Open Stack, and T-Systems’ own enterprise IaaS offering Dynamic Services for Infrastructure.

T-Systems Cloud Broker and Compatible IaaS

Secure or Public Access
The broker offers two delivery models with distinct types of network connection: via the public Internet or a VPN. The public and secure private services run in separate environments. This allows users to ensure the level of protection they require at connection level. Moreover, the software itself is operated on a highly secure platform.

Registration and Access Rights
Businesses that want to use Cloud Broker must register with T-Systems – ensuring complete transparency for user organization and provider. Depending on the service class, a defined scope will be agreed in terms of migration and access channels for managing a set number of virtual machines. The IT department assumes a gatekeeper function, assigning access rights to users within the company. The virtual machines are deployed on the basis of a separate (in some cases pre-existing) contract between the user organization and the IaaS provider.
FINDING THE RIGHT SERVICE WITH THE DECISION ENGINE
By completing some simple fields, users can tell the broker what they require: in terms of price, technical parameters, or compliance requirements such as the location of the data center. The integrated decision engine responds with a selection of cloud services, from which the user can choose the resources they want with a simple click. The broker then provisions the necessary virtual machines, with the user entering the relevant parameters and establishing access to the necessary data. The service is launched with a simple click – and can be stopped and restarted by the user at any time. In addition, Cloud Broker provides an overview of all provisioned machines.

IT DEPARTMENT AS THE GATEKEEPER
In its gatekeeper role, the IT department has access to extensive reporting functionality that communicates the status of all running systems, including virtual systems that are provisioned on-premises. Moreover, the broker can provide details of resource consumption per user, department and project, and can break this down for specified time periods. Plus, it keeps track of spending and monitors billing processes, creating the basis for unified internal cost allocation across all providers.

ONE-CLICK MIGRATION
Once it gains access to Cloud Broker, the user organization also acquires its own storage space in a T-Systems data center, which is used to support migration from one IaaS provider to another. The transformation engine moves the entire service from the original cloud location into a virtual data container. This is temporarily parked in the T-Systems data center, where, if necessary, the image file format is modified in line with the new platform before being transferred to the target IaaS environment. Even in the unlikely event of a Cloud Broker outage, the process is not negatively impacted.
Whether CIOs take an active role in shaping adoption or user departments carve out their own cloud niches, one thing is clear: cloud computing has become a fact of life in today’s enterprises. Cloud brokerage, on the other hand, is a brand new topic – yet one that is already answering real-world business concerns.

Most users expect the IT department to perform the tasks of a cloud broker. However, it appears the approach is not on the radar of the vast majority of enterprises: a mere 7 percent of companies deploy cloud broker services, and a full 79 percent have never even considered the option. Yet IT departments would be wise to start thinking about cloud brokerage early in the game, and to begin planning an implementation strategy. Involving an external service is a fast and effective way of reconciling both sides of the cloud world within the company.

For CIOs, it is difficult to put a precise figure on the return on investment following implementation of a cloud broker. Licensing fees must be offset against the huge improvements in transparency and IT compliance. What can be calculated is the time saved on selecting providers and migrating virtual containers. Any cost-benefit analysis must weigh up these plus points with the price of licenses or development and operating costs, if the decision is taken to create an in-house solution.

Ultimately, the IT department will opt for an automation solution when the manual effort of managing external and internal IaaS resources reaches a critical point. The more widespread the use of external IaaS in the company and the greater the demand from user departments, the more sense it makes to introduce a broker solution. The decision will depend to a large extent on governance requirements, the company culture and the degree of IT dependency in the business. If use of external IaaS is limited, a broker is not necessary.

**EXPENSES**
- Licensing costs
- Implementation costs (organizational and technical)
- If developing in-house solution: time and expenses required for development, operating costs

**SAVINGS/BENEFITS**
- Cost reduction for IaaS use
- Transparency
- IT compliance
- Automated management of the IaaS landscape
- Faster selection of providers
- Simplified migration

Of course, cloud brokerage also provides the IT department with an opportunity to improve its standing with user departments – by positioning itself as a business enabler and driver of cloud computing. At the same time, it offers CIOs a chance to regain control over cloud usage, allowing them to rein in the sprawl of services and effectively implement governance strategies.

Cloud brokers are set to become the focal point for cloud ecosystems. For now, the spotlight is on IaaS services that are easy to standardize. But there is nothing to say that future solutions will not also expand to include PaaS and SaaS, becoming a ‘one-stop shopping center’ for all cloud services. An important caveat, however, is that there is far greater variation among platform and software offerings, hindering their deployment as an infrastructure-style ‘commodity’. But whatever the services on offer, the broker marketplace should be easy to work with and attractively designed – in order to create a user-friendly e-shopping experience that enhances acceptance.
The potential of brokerage solutions is not limited to the type of resources on offer. There are also promising development opportunities in terms of the functionality – for example, policies, compliance issues, and legal requirements could all be managed automatically. This would relieve IT department staff of routine tasks, leaving them free to spend time on innovative projects that strengthen their enterprise’s competitive advantage.

Finally, cloud broker platforms give companies with their own IT resources the opportunity to improve their return on investment by offering their infrastructure and services on the marketplace. Once these structures are in place, one of the great promises of cloud computing will become a reality: the emergence of a company- and provider-independent pool of IT resources, which businesses can access as needed – supporting a variety of usage scenarios and enabling transparent price comparison.

“If IT departments want to offer end users a fully automated IT purchasing platform, they must become service brokers for their own organization. This means bringing together diverse offerings from a range of providers, enabling self-service options for resource delivery and management, and granting rights-based access to applications via a portal.”

451 Research
# Glossary

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<tr>
<td>BPAAS</td>
<td>BPaaS stands for 'business process as a service'. It describes software delivered from the cloud that supports an entire business process or part of a process.</td>
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<tr>
<td>DECISION ENGINE</td>
<td>The element of a cloud broker solution that compares offerings on the basis of pre-defined parameters before automatically selecting a service.</td>
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<td>GATEKEEPER</td>
<td>An individual or a software tool that controls and manages access to resources.</td>
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<tr>
<td>IDENTITY MANAGEMENT</td>
<td>Administration of user access to the cloud broker, including rights management.</td>
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<tr>
<td>IAAS</td>
<td>IaaS stands for 'infrastructure as a service'. It describes the lowest tier of the cloud services spectrum, which provisions computing and storage resources in line with user requirements.</td>
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<td>METERING</td>
<td>Metering measures the resources provisioned and deployed, enabling services to be billed in line with usage.</td>
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<td>MULTI CLOUD</td>
<td>A multi-cloud IT landscape is characterized by multiple providers delivering cloud resources from both internal and external pools.</td>
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<td>PAAS</td>
<td>PaaS stands for 'platform as a service'. It describes the delivery of runtime environments, middleware and development platforms from the cloud.</td>
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<td>PUBLIC CLOUD</td>
<td>Public cloud providers deliver cloud services via network connections that do not include additional security mechanisms (e.g. over the Internet).</td>
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PRIVATE CLOUD
Private cloud providers deliver cloud services from a technically secured, sometimes physically separated environment.

SAAS
SaaS stands for ‘software as a service’. It describes the delivery of complete applications from the cloud with full functionality, designed for end users who do not necessarily have in-depth IT knowledge.

SERVICE CONTAINER
A complete description of a service or an application landscape that runs on a virtual machine, logically separated from the infrastructure. Service containers make it possible to move the service from one infrastructure environment to another.

SERVICE LAYER
A technical level containing the automation mechanisms that enable the functionality of the cloud broker. These mechanisms draw on the virtualization and cloud management functionality that reside in the layer below.

SOURCING MIX
The combination – planned or unintended – of IT resources that make up the overall IT landscape of an enterprise.

TRANSFORMATION ENGINE
An element of cloud brokers that allows a service operated in a service container to be migrated from one infrastructure platform (virtual machine) to another.
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| FIG. 6 | PUBLIC AND PRIVATE CLOUD BROKER MODELS |