

AN ANALYSIS OF THE SOFTWARE SOLUTIONS FROM THE WORLD'S IAAS CLOUD SERVICES PROVIDERS

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Abstract: Over the last few years, interest in renting Cloud Infrastructure as a Service (IaaS) has increased and this has led to the development of many new solutions of this class. The competition on this market resulted in serious changes in the business strategies of the providers of IaaS cloud services. We are witnessing an incredibly dynamic development of the IaaS market. This requires the thorough analysis of the current possibilities of the providers of such products and the direction in which they will be developing in the near future.

The objectives of the present article are to analyse the characteristics, advantages and disadvantages of the IaaS solutions of the world's leading providers of cloud services and to offer recommendations with reference to choosing an effective cloud configuration.

To achieve the set goals, the study has used the Gartner's Magic Quadrant research methodology; has collected and summarised data from the studied providers of IaaS cloud services and, based on these results has outlined parameters that can be used to analyse, compare and assess the leading world IaaS solutions.

Key words: providers of IaaS solutions, cloud services.

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¹ The separate parts of the article are written as follows: Assoc. Prof. N. Marinova – abstract, introduction and part I; Ph.D. student B. Boychev – part II and conclusion.

Introduction

The success of modern business organisations that work by using intensively on – demand services, mobile applications and interactive elements to a great extent depends on the possibilities for effective processing of transactions and maintaining the busy working process of information infrastructures designed in them. One way to achieve a better functionality with reference to this is the implementation of scalable IT resources.

Cloud Computing technology permits remote network access to a number of scalable computing resources, which can be quickly rented by organisations or services providers. Cloud computing has shifted the paradigm towards standardisation and has orientated itself towards services. This has led to the development of a number of new technological solutions in the information and telecommunications industry.

There are three cloud delivery models available for business organisations, i.e. Software as a Service (SaaS), Platform as a service (PaaS) and Infrastructure as a Service (IaaS). IaaS is probably the fastest developing and most promising model of cloud services at present². The implementation of this model, however, faces certain challenges connected with the manner of managing the separate technological components and modules, the integration of the heterogeneous interfaces, the provision and payment of the resources according to the degree of their usage and the ways of securing the data protection and privacy.

With reference to this, it is a very **pertinent** issue to evaluate the multitude of market providers of IaaS products because each of them offers a specific type of service, functionality and pricing model. Often the solutions of the different providers are not compatible and users find it difficult to determine the criteria, which will determine their choice.

² According to the TechNavio analysts, globally the revenues from IaaS software, resources, applications, services, support and maintenance will increase by 42,9% for the period 2014-2019. Source: Global IaaS Market 2015-2019, December 2014, p. 79. <<http://www.reportsnreports.com/reports/319905-global-infrastructure-as-a-service-iaas-market-2015-2019.html>>. Retrieved on 03.06.2016 r.

I. IaaS cloud solutions of leading world providers

Infrastructure as a Service (IaaS) allows users to process data, store data and information, use networks and other fundamental computing resources. Users are also able to deploy and run arbitrary software, which can include operating systems and applications³. Consumers do not manage or control the underlying cloud infrastructure but have control over the operating systems, storage and rented applications. Consumers can also be given limited control over selected network components such as host firewalls, for example.

The IaaS concept is characterised by the fact that the computing resources are provided on demand after a limited or no - initial investment paid by consumers. The use of these resources, however, is easily scalable and multidimensional. Customers can use the service without a long – term commitment but they often sign lengthy contracts motivated by the lower price. IaaS services are provided over the Internet and in most cases are managed entirely by another provider who makes a profit from the number of subscribers through economies of scale and the costs for maintaining a smaller number of virtualized platforms^{4,5}.

In order to obtain a more clear idea of the dynamics of the IaaS cloud services market over the last year we use as a starting point the Gartner's Magic Quadrants to assess the positions of the leading world providers of such solutions for the period 2012 – 2015^{6,7,8,9}. Gartner

³ See **Mell, P.**, Grance, T. The NIST Definition of Cloud Computing. National Institute of Standards and Technology, Information Technology Laboratory. 2011. p. 3, <http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>

⁴ See **Armbrust, M.**, Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., Patterson, D., Ariel Rabkin, I., Zaharia, M. A View of Cloud Computing. // *Communications of the ACM*, 2010, №53 (4), p.50-58.

⁵ See **Koehler, P.**, Anandasivam, A., Dan, M. Cloud Services from a Consumer Perspective// *16th Americas Conference on Information Systems (AMCIS)*. Lima, Peru, 2010,

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.174.6121&rep=rep1&type=pdf>

⁶ See **Leong, L.**, Toombs, D., Gill, B., Petri, G., Haynes, T. Magic Quadrant for Cloud Infrastructure as a Service 2012. Gartner, 2012. p.1-33.

separates the analysed firms into four groups, i.e. players in the main niche, visionaries, challengers and leaders. At the end of 2015, in the leading sectors there were only two providers – Amazon and Microsoft (they will be thoroughly discussed in part II of the article).

It is also interesting to study the smaller providers, namely Google, CenturyLink, Rackspace and Verizon, whose IaaS cloud solutions demonstrate performance indicators and interface that can compete with the ones of the leaders. Therefore, we will compare the products of these key providers in particular. We will use several basic **indicators**, which reflect the specific characteristics of cloud computing, i.e. *payment options, discounts on service prices, guarantees in the service level agreements for software use, options for configuring services and location of data centres according to continents*¹⁰.

1) **“Payment Options” Parameter**

The possible options for paying the IaaS Cloud services offered by each of the compared providers are several: per less an hour, per hour, per month, per year and for a period of three years (see Table 1).

<https://virtualizationandstorage.files.wordpress.com/2013/02/magic-quadrant-for-cloud-infrastructure-as-a-service.pdf> [13.05.2015]

⁷ See **Leong**, L., Toombs, D., Gill, B., Petri, G., Haynes, T. Magic Quadrant for Cloud Infrastructure as a Service 2013, Gartner, 2013. p.1-42.
http://www.distributioncentral.com/docs/Magic_Quadrant_for_Cloud_Infrastructure_as_a_Service.pdf [13.05.2015]

⁸ See **Leong**, L., Toombs, D., Gill, B., Petri, G., Haynes, T. Magic Quadrant for Cloud Infrastructure as a Service 2014. Gartner, 2014. p.1-26.
<http://www.infomall.org/1590ABDSSoftware/Resources/Magic%20Quadrant%20for%20Cloud%20Infrastructure%20as%20a%20Service.pdf> [13.05.2015]

⁹ See **Leong**, L., Toombs, D., Gill, B. Magic Quadrant for Cloud Infrastructure as a Service 2015. Gartner, 2015. p.1-38.
<http://www.gartner.com/technology/reprints.do?id=1-2G45TQU&ct=150519&st=sb> [13.05.2015]

¹⁰ The data used in the comparison of the four providers is relevant as of May 2016. The information is taken from the websites of CenturyLink (<https://wwwctl.io>), Google (<https://cloud.google.com>), Rackspace (<http://www.rackspace.com>) and Verizon (<http://www.verizonenterprise.com>).

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*Table 1.
Payment options for the services offered within the IaaS solutions of the compared providers*

Payment Options \ IaaS cloud service	CenturyLink Cloud	Google Compute Engine	Rackspace Cloud	Verizon Cloud
< 1 hour	No	Yes	Yes	No
Per hour	Yes	No	No	Yes
Per month	No	Yes	No	No
Per year	No	No	Yes	No
For 3 years	No	No	Yes	No

From the table it is clear that Google and Rackspace offer clients the possibility to rent IaaS cloud services for less than hour, which is an option for an additional reduction of costs for the business organizations.

2) “Discounts on Service Prices” Parameter

In addition to different payment options, providers also discounts of prices (see Table 2) based on duration of use of the solution, volume of consumption or the combination of both. Two of the compared providers offer discounts for reducing the hourly costs. The information about CenturyLink and Verizon is not available to the public.

Google calculates the discount on the basis of virtual machine use for the entire month. The quoted discount of 60% is offered during the fourth week of each month.

Rackspace offers discounts after a monthly use of services amounting to \$5000. The discount on the minimum required usage can be combined with a long-term commitment (6, 12, 18, 24 or 26 months) for the realization of even bigger savings. The maximum discount for Rackspace clients is 37%.

Table 2.

Discounts on prices for the services that are part of the IaaS solutions of the compared providers

IaaS cloud services	Maximum reduction of the by – the – hour costs
CenturyLink Cloud	No data available publicly
Google Compute Engine	60%
Rackspace Cloud	37%
Verizon Cloud	No data available publicly

Based on the data presented in the two tables, we can recommend users to choose the Google Compute Engine IaaS solution because it has better and clearer terms of use with reference to price. In addition, the discount for this service is higher.

3) "Guarantees in the Service Level Agreement about Software Use" Parameter

Most providers sign a service level agreement (SLA) with their clients to guarantee the quality of the offered IaaS cloud service. Some companies offer different agreements for each of their services. Users have to check whether the provider offers to refund payments as cash or a credit for future usage of its services in case of breaching the guarantee. The table below shows what guarantees are offered for each of the compared solutions.

Table 3.

SLA guarantees for the IaaS solutions of the compared providers

IaaS cloud service	CenturyLink Cloud	Google Compute Engine	Rackspace Cloud	Verizon Cloud
SLA guarantees				
Uptime guarantee (Guarantee for the time during which the services are available)	99,99%	99,95%	99,90%	-
Grace period before the moment of putting a claim for compensation in cases of breaking the SLA	15 minutes	1 month	1 month	-
Compensations in cases of breached guarantees	The size varies	10-50%	10-30%	-

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The information from Table 3 reveals that CenturyLink Cloud offers the biggest uptime guarantee (for the time during which the services are available) and the possibility for the fastest making of compensation claims. With reference to compensations, their size varies due to the possibility to changes in the used configuration. Therefore, regarding the evaluation of the responsibility towards customers, guaranteed through the SLA, we recommend them to choose CenturyLink Cloud over the other four providers.

3) **“Service Configuration Options” Parameter**

Except on the basis of the different payment options, the IaaS solutions can be differentiated in three groups according to the possibilities for configuring cloud server components (number of CPU cores, random access memory (RAM) and storage). The solutions with fully configurable services (see Table 4) do not limit scalability. The services with partly configurable services limit scalability to a predetermined packet of services while the ones with non- configurable services offer packet cloud resources that cannot allow clients to personalize the hardware (a change in any piece of resource requires from clients to change their available packet so that it meets their technical requirements).

Table 4.

Options for configuring services within the framework of the IaaS solutions of the compared providers

Service configuration options \ IaaS cloud service	CenturyLink Cloud	Google Compute Engine	Rackspace Cloud	Verizon Cloud
Fully configurable services	Yes	-	-	-
Partly configurable services	-	-	-	-
Non – configurable services	-	Yes	Yes	Yes

Of the four providers, only CenturyLink Cloud offers fully configurable services. This enables the business organisations, which have chosen this company, to be considerably more flexible and scalable. For this reason, we think that CenturyLink Cloud is the most adequate solution for organization whose business needs change dynamically.

4) **“Data Centres Location” Parameter**

With reference to the location of the data centres in different geographical regions, it should be noted that each of the four providers have data centres in the North – American, European and Asian – Pacific regions. However, only Verizon has a data centre in the South – American region (see Table 5). For this reason, the Verizon Cloud IaaS solution is supported not only in English but also in Spanish and Portuguese. The only disadvantage is that the portal and the documentation are only in English.

*Table 5.
Location of the data centres of the compared providers*

IaaS cloud service Geographical region	CenturyLink	Google	Rackspace	Verizon
North America	9	1	3	7
South America	-	-	-	1
Europe	3	1	1	2
Asia – Pacific region	1	1	2	1

We can **conclude** that in today’s dynamic business environment the most appropriate choice out of the four providers of cloud infrastructure is CenturyLink. This opinion is based on the demonstrated possibilities for flexibility and scalability, a considerable uptime guarantee and a short period before making claims for breaking the service level agreement. Another advantage of this solution is the easy calculation and planning of costs due to the ‘per hour’ payment option and the possibilities for negotiating discounts based on used resources and length of their usage.

II. Analysis of the solutions of the leading providers of IaaS cloud services

At present, the biggest provider of IaaS cloud solutions is Amazon, followed by Microsoft. In the following part of the article, we will compare

the basic solutions of the two leading companies, namely Amazon Web Services (AWS) and Microsoft Azure Infrastructure Services. To do this we use several parameters, i.e. *computing power, storage, network maintenance and pricing model*¹¹.

1) “Computing Power” Parameter

EC2 (Elastic Compute Cloud) AWS is the basic cloud service of Amazon. Users can rent preconfigured virtual machines or customised machine images (Amazon Machine Images (AMI)). They can choose the size, strength and capacity of the memory as well as the number of the virtual machines. Users can also select the region and zone within whose framework they can run the virtual machines. In addition, EC2 allows for balancing the load and the automatic scaling of the IaaS service capacity for achieving better productivity.

The Azure's instrument for creating virtual machines is Virtual Hard Disk (VHD), which is an equivalent of Amazon's AMI. Microsoft Azure Infrastructure Services also have an option that allows users to configure the virtual machines independently and in advance. The only thing users have to do is to specify the number of cores and the volume of memory they would like to use.

With reference to the “Computing power” parameter, Amazon offers a bigger choice of cloud configurations (38) and only it allows its clients to choose the zone where the virtual machine will be configured and run. Due to this possibility for selecting both a region and a zone, clients can better consider the location where the law regulations match best the needs of their business and stimulate the development of a more effective working environment.

2) “Data Storage” Parameter

The AWS service offers several data storage options:

- Ephemeral (temporary) storage permits users to delete data when the specific configurations is not supported anymore;

¹¹ The data used in the comparison of the providers is relevant as of May 2016. The information is taken from the websites of Amazon (<http://aws.amazon.com>) and Microsoft (<https://azure.microsoft.com>).

- Block Storage is equivalent to using hard disks and allows users to deploy the stored information to the disk memory in any virtual machine or to store it separately from them) through the EBS service;
- Object storage of data through the S3 service;
- Data archives available through the Glacier service;
- Maintenance of relational databases;
- Maintenance of NoSQL databases and Big Data through the DynamoDB, EMR, Kinesis and Redshift services.

The Microsoft Azure Infrastructure Services offer the following data storage options:

- Temporary storage – the D drive service;
- Block storage for the volumes in the virtual machines – the Page Blobs service
- Object storage – the Block Blobs and Files services;
- Archive storage in SQL databases;
- Maintaining relational databases;
- Maintaining NoSQL databases and Big Data through the Windows Azure Table and HDInsight services.

In **conclusion**, we can sum up that both providers of IaaS cloud services offer similar data storage options to their customers (see Table 6). Therefore, the determining factor in choosing a provider with reference to this parameter is mainly the price of the offered services.

*Table 6.
Comparison of the data storage features of Amazon Web Services and Microsoft Azure Infrastructure Services*

IaaS cloud service	Amazon Web Services	Microsoft Azure Infrastructure Services
Ephemeral storage	Yes	D drive
Block Storage	EBS	Page Blobs
Object Storage	S3	Block Blobs and Files
Archiving	Glacier	SQL Database
Relational databases	Relational DSs	Relational DBs
NoSQL and Big Data	DynamoDB, EMR, Kinesis, Redshift	Windows Azure Table, HDInsight

3) “Network Maintenance” Parameter

The virtual private clouds (VPC) of Amazon and the Virtual Network (VNet) of Azure enable customers to connect groups of virtual machines in isolated networks within the cloud. With the VPC and VNet services, customers can determine the topology of the networks. They can also create sub-networks, routing tables, ranges of private IP addresses and networking gateways. Both providers have firewalls and offer their customers the option of creating a hybrid cloud. The considerable difference between the two companies, however, is the unique DNS web service of AWS, namely Route 53 (see Table 7). Route 53 is extremely useful for clients because it can make the management of the network maintenance much easier. Therefore, regarding this parameter, we recommend them to choose Amazon.

*Table 7.
Comparison of the network features of Amazon Web Services and Microsoft Azure Infrastructure Services*

IaaS cloud service	Amazon Web Services	Microsoft Azure Infrastructure Services
Virtual network	VPC	VNet
Public IP	Yes	Yes
Hybrid cloud	Yes	Yes
DNS	Route 53	-
Firewall/ACL	Yes	Yes

4) “Pricing model” Parameter

AWS clients are charged for the number of hours during which they use the service, an hour being the minimum amount of time required. To use Amazon’s services, clients pay for every hour even if they do not use it up completely. The AWS resources can be obtained by using one of the following three models:

- On demand – clients pay for what they use without any prepayments;
- By reserving them – the resources are rented for a period of 1 or 3 years after making in advance payment;
- Spot – users bid for using additional cloud resources.

When using the Microsoft Azure Infrastructure Services, customers pay the number of the ordered minutes by rounding up after calculating them. Azure also offers short – term contracts with discounts valid for Microsoft customers who hold an Enterprise License Agreement.

A comparison of the pricing models from the two providers is presented in table 8:

*Table 8.
Comparison of the pricing models of Amazon Web Services and Microsoft Azure Infrastructure Service*

IaaS cloud service	Pricing	Models
Amazon Web Services	By the hour with rounding up	<ul style="list-style-type: none">• on demand• reservation of resources• spot
Microsoft Azure Infrastructure Services	By the hour with rounding up valid until the order lasts	<ul style="list-style-type: none">• on demand• short – term contracts (prepaid or monthly) with discounts for Microsoft clients

When evaluating the pricing models of the compared solutions, we recommend users to analyse the computing workload and the length of using the cloud resources. If the resources are used for less than an hour, it is preferable to choose Microsoft Azure Infrastructure Services because clients can make bigger economies. If the usage period is longer, the IaaS cloud services of Amazon will be the better choice because of the bigger discounts on the price when clients sign long – term contracts.

We will finish the analysis of the leading solutions in the field of IaaS cloud services by outlining the main **advantages and disadvantages** of their providers.

The undoubted leadership of Amazon in the provision of cloud infrastructure during the last years has allowed the company to attract

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many technological partners such as providers of software, developed especially for AWS. Amazon has a big network of partners who provide expert knowledge for the development of new applications, management services and professional services, which facilitate the migration of the data centre.

Amazon offers the biggest choice of functionalities as part of its IaaS and PaaS cloud solutions. What is more, it continues to expand its range of solutions, including higher-class solutions. This has allowed the company to occupy the leading position among the cloud infrastructure providers. In its report, Gartner points out that the American company offers to its customers computing power, which is 10 times bigger than that of all the other 14 providers included in the Magic Quadrant taken together.

Despite the undoubted leading position of Amazon, customers and specialists should not underestimate Microsoft products. Although the company has been on the IaaS services market for a short period, it has launched many new functionalities and services, including differentiated capabilities. The company has a vision for infrastructure and platform services that not only run independently but also in compatibility with its local information infrastructure (Hyper-V, Windows Server, Active Directory and System Center), development tools (including Visual Studio and Team Foundation Server) and various SaaS solutions.

Over the last two and a half years, this Microsoft service has become very popular and has already become the second best player on the market with reference to market share. The company offers to its customers computing power, which is 2 times bigger than that of the other 13 providers in the Magic Quadrant (outside of the Leaders sector) together. Microsoft prices for end – users are compatible with those of Amazon while customers holding an Enterprise License Agreement receive discounts on prices. This makes the price/ performance ratio comparable to that of AWS and is a serious prerequisite for increasing the number of customers who use Microsoft Azure Infrastructure Services.

Although we outlined advantages and disadvantages of the two providers, we have to point out that each of them has its **problems**. One of the main weaknesses of the Amazon's product is its more complicated management. Although it is the market leader with reference to price, we

strongly recommend that customers use additional tools from third party providers to manage their costs. This is due to the packages that are offered in some cases.

Another serious disadvantage of AWS is the available options for maintaining the solution. These possibilities are differentiated on the basis of the service level that a particular customer buys. To guarantee better maintenance, customers must pay for a Business Level and this increases considerably their total costs.

Another possible problem that may occur with the development of IaaS cloud services is their interference with the functional areas of the traditional IT providers. This can lead to conflicts between Amazon and some of its technological partners and therefore harm the work process.

There are problems with Microsoft's product too. After Microsoft Azure Infrastructure Services launched on the market, there have been many interruptions in the functioning of the solution. For this reason, many organisations are worried that they might need to look for another software, different from the one provided by Microsoft, to restore their critical applications after a possible disaster.

Another serious disadvantage is the technological partner network, which is not very well – developed. Many of Microsoft's partners do not have considerable experience working with the Azure platform, which may lead to compromising with the quality of the solutions offered to customers. Although customers can run heterogeneous applications in the IaaS environment of Azure, this reduces the solution attractiveness for the organisations, which do not prefer Microsoft products.

Both Amazon Web Services and Microsoft Azure Infrastructure Service have their strengths and weaknesses and can be used for different business purposes. When customers choose an IaaS provider they must take into consideration the complex corporate cloud applications that must be rented and how their architecture will fit the existing information infrastructure. In our opinion, we recommended choosing AWS because it has better technical capabilities. If companies use mainly Microsoft products, it is advisable for them to choose the services of Azure.

In **conclusion**, we consider that in the near future Amazon will preserve its leading position on the market of IaaS cloud services. Despite

this, we expect an improvement in the Microsoft Azure Infrastructure Service position because this will make the competition between the two providers tougher. As a result, the quality of the offered services will increase while prices will decrease. This, however, will worsen even more the position of the niche players. We also consider that it is possible that some of the niche players will drop out of Gartner's Magic Quadrant due to an inability to offer competitive prices for their services.

Conclusion

The choice of IaaS provider is a difficult task for any organisation that has decided to start using a cloud infrastructure. We recommend doing this after analysing the actual needs for additional computing power and disk space for storage and data backup. This will help the organisations to formulate appropriate criteria for choosing an IaaS cloud product. In addition, it is advisable for the people who make the decision to have enough information about the different methods of price formation so that they can choose the most appropriate one for them.

Finally, we can say that an adequate choice of IaaS cloud services provider must be done after a thorough assessment of the needs and financial capability of the particular organisations. When this analysis is performed, organisations can proceed by comparing the providers' offers and choose the cloud configuration that best matches the needs of their organisations.

References

1. Altskeil Bulgaria EOOD, 2016, <https://altscale.com/bg/home>
2. Daticum AD, 2016, <https://www.daticum.com/>
3. Internet Korporeited Networks EOOD, 2016, <https://www.icn.bg/bg/cloud-create.html>
4. Klaudsigma EOOD, 2016, <https://www.cloudsigma.com/>
5. Netera EOOD, 2016, <http://cloudware.bg/bg/cloud-server>
6. Raks.BG EOOD, 2016, <https://www.rax.bg/bg/cloud/>

7. Amazon, Amazon Web Services, 2016, <http://aws.amazon.com>
8. Armbrust, M., Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., Patterson, D., Ariel Rabkin, I., Zaharia, M. A View of Cloud Computing. // *Communications of the ACM*, 2010, №53(4), p.50-58.
9. CenturyLink, CenturyLink Cloud, 2016, <https://wwwctl.io>
10. Global IaaS Market 2015-2019, December 2014, p. 79. <<http://www.reportsnreports.com/reports/319905-global-infrastructure-as-a-service-iaas-market-2015-2019.html>>
11. Google, Google Compute Engine, 2016
<https://cloud.google.com>
12. **Koehler**, P., Anandasivam, A., Dan, M., Cloud Services from a Consumer Perspective// *16th Americas Conference on Information Systems (AMCIS)*. Lima, Peru, 2010,
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.174.6121&rep=rep1&type=pdf>
13. Leong, Lydia et al. Magic Quadrant for Cloud Infrastructure as a Service 2012./ Lydia Leong, Douglas Toombs, Bob Gill, Gregor Petri, Tiny Haynes. - Gartner, 2012. p.33.
<https://virtualizationandstorage.files.wordpress.com/2013/02/magic-quadrant-for-cloud-infrastructure-as-a-service.pdf>
14. Leong, Lydia et al. Magic Quadrant for Cloud Infrastructure as a Service 2013./Lydia Leong, Douglas Toombs, Bob Gill, Gregor Petri, Tiny Haynes. - Gartner, 2013. – p.42.
http://www.distributioncentral.com/docs/Magic_Quadrant_for_Cloud_Infrastructure_as_a_Service.pdf [13.05.2015]
15. Leong, Lydia et al. Magic Quadrant for Cloud Infrastructure as a Service 2014./Lydia Leong, Douglas Toombs, Bob Gill, Gregor Petri, Tiny Haynes. - Gartner, 2014. – issue 2.
<http://www.infomall.org/I590ABDSSoftware/Resources/Magic%20Quadrant%20for%20Cloud%20Infrastructure%20as%20a%20Service.pdf> [13.05.2015]
16. Leong, Lydia et al. Magic Quadrant for Cloud Infrastructure as a Service 2015./Lydia Leong, Douglas Toombs, Bob Gill. - Gartner, 2015. p. 38.
<https://www.gartner.com/doc/3056019/magic-quadrant-cloud-infrastructure-service>

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17. Mell, P., Grance, T. The NIST Definition of Cloud Computing. National Institute of Standards and Technology, Information Technology Laboratory. 2011.
<http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>
18. Microsoft, Microsoft Azure Infrastructure Services, 2016,
<https://azure.microsoft.com>
19. Rackspace, Rackspace Cloud, 2016,
<http://www.rackspace.com>
20. Verizon, Verizon Cloud, 2016,
<http://www.verizonenterprise.com>

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- Name of article, name of author, scientific degree, scientific title - font Times New Roman, 14pt, capital letters Bold - justified;
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