

Overview of Cloud Computing for London Bikes Ltd

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0. Abstract

This paper main goal to introduce Cloud Computing technologies and its opportunities to London Bike Ltd, whom has keen on to use this new service of IT sector. The report will reflect the advantages and disadvantages of using cloud services, while it presents the main core and related definition, possible solution and challenges of cloud service. All this will demonstrate with examples and articulate explanation to help understanding all employees, who are not at home with all cloud computing related staff. Author hopes the report will give a bright picture about this service the whole range of workers, no matter how they connect to use that after implementation and help London Bike Ltd make a accountable and useful decision about installation of a cloud service.

1. Introduction to Cloud Computing

To understand what Cloud Computing is first define it. This is not an easy task, because developers and scientist are still not agreed a proper definition. That's because this service is so diversified if looking its possibilities and layers. First, look what experts said, Peter Mell and Timothy Grance words about this service: *"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."* (Mell, Grance, 2011).

Another expert, in 1997, Professor Ramnath Chellapa of Emory University defined Cloud Computing as the new *"computing paradigm, where the boundaries of computing will be determined by economic rationale, rather than technical limits alone."*

Now eye one of the providers, who offers this service, what is Amazon's version: *"Cloud computing is the on-demand delivery of IT resources over the Internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider like Amazon Web Services (AWS)." (AWS Amazon, 2020).*

Let share the author his own definition or meaning: Cloud Computing is an aggregated IT services which contains many kinds of services, such as hosting, storing, applications. Services without boundaries, place of users and place IT functionalities is divided. All services are based on an internet connection. Solution is delivered by the needs of company. These needs determine the depth and complexity of services. May these different definitions be show how complex and difficult the Cloud Computing, even to define is not simple.

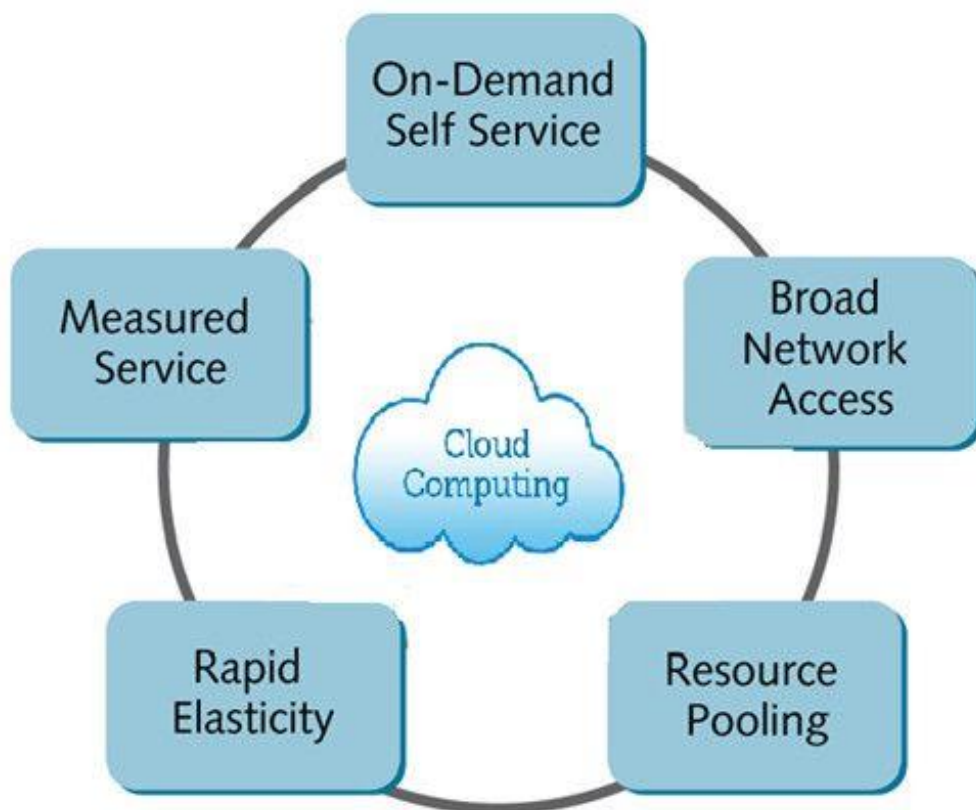
2. Characteristics, model and type of Cloud Computing

Cloud Computing has many different angles to class them. It delivers various models and integrates a lot of existing solution and technologies.

2.1. Characteristics of Cloud Computing

Dissimilarly, like in question of Cloud Computing definition, in question of Cloud Computing characteristics is a comprehensive agreement. The five essential characteristics of Cloud Computing are follows:

- 1) On-demand self-service
- 2) Broad network access
- 3) Elastic resource pooling
- 4) Rapid elasticity
- 5) Measured service



Picture #1: Five characteristics of Cloud Computing (source: <https://gr.pinterest.com/jemishrajpara/>)

According Mell and Grace the definition of characteristics:

- 1) *“On-demand self-service: A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.*
- 2) *Broad network access: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops and workstations).*
- 3) *Resource pooling: The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state or datacenter). Examples of resources include storage, processing, memory and network bandwidth.*
- 4) *Rapid elasticity: Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.*
- 5) *Measured service: Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency for the provider and consume. (Mell, Grace, 2011)”*

Meaning and benefits of above for a company is:

- 1) On demand self-service: changes of IT needs is not a issue and negotiating with IT department, only a quick request for provider in agreed service level access.
- 2) Broad network access: access of company's data's or files is more simple and non-stationary. Information is available by various device (mobile phones, laptops, tablets) from various places. Workstation exclusivity is not an issue anymore.
- 3) Resource pooling: any resources changes become a service, not an investment anymore. These changes are two-way, depend on resources requirements could be increase or decrease the level.
- 4) Rapid elasticity: There are no limits of shifts. Service level always follows the requirements of company. This modification is two-way also, handling a busy period is not a challenge anymore.
- 5) Measured service: cloud system automatically measures number of users, their process and performance. As workflow is monitored on whole system, paying for service is based on consume.

These are basic features of Cloud Computing, other benefits and non-benefits will discuss later.

2.2. Models of Cloud Computing

Cloud Computing is a such a complex bunch of services. SaaS, PaaS and IaaS are three model of cloud services, however very difficult to establish exact borders between them recently, when this sector of IT evolving rapidly. Before we look deeper in SaaS, PaaS and IaaS clear what these three acronyms for? SaaS means Software as a Service; PaaS means Platform as a Service and IaaS means Infrastructure as a Service.

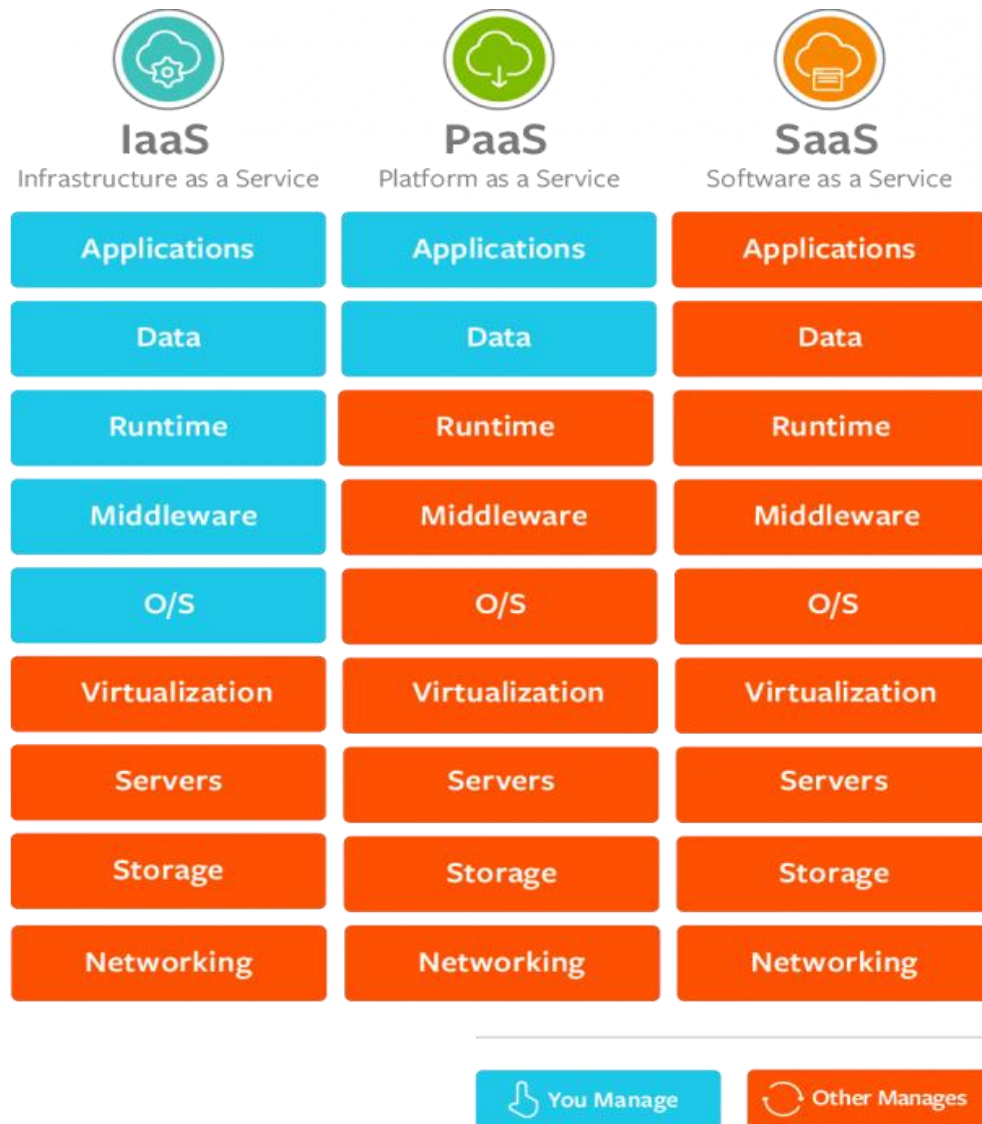
- *“Software as a Service offers applications that are accessed over the web and are not managed by your company, but by the software provider. This relieves your organization from the constant pressure of software maintenance, infrastructure management, network security, data availability, and all the other operational issues involved with keeping applications up and running. SaaS billing is typically based on factors such as number of users, usage time, amount of data stored, and number of transactions processed. This service model has the largest market share in cloud computing.”* (www.openitl.com, 2019).
- *“Platform as a Service is halfway between Infrastructure as a Service (IaaS) and Software as a Service (SaaS). It offers access to a cloud-based environment in which users can build and deliver applications without the need of installing and working with IDEs (Integrated Development Environments, which are often very expensive. Additionally, users can often customize the features they want included with their subscription. PaaS has the smallest market share of the three service models.”* (www.openitl.com, 2019).
- *“Infrastructure as a service offers a standardized way of acquiring computing capabilities on demand and over the web. Such resources include storage facilities, networks, processing power, and virtual private servers. These are charged under a “pay as you go” model where you are billed by factors such as how much storage you use or the amount of processing power you consume over a certain timespan. In this service model, customers do not need to manage infrastructure, it is up to the provider to guarantee the contracted amount of resources and availability.”* (www.openitl.com, 2019).

Best way to know and understand model of Cloud Computing, is to give some exist example that specific belong one of the models.

SaaS	PaaS	IaaS
BigCommerce	Apache Stratos	Amazon Web Service (AWS)
Cisco WebEx	AWS Elastic Beanstalk	Cisco Metapod
Concur	Force.com	Digital Ocean
DocuSign	Google App Engine	Google Compute Engine
Dropbox	Heroku	Linode
GoToMeeting	Magento Commerce Cloud	Magento 1 Enterprise Edition
Google Apps	Openshift	Microsoft Azure
Hubspot	Windows Azure	Rackspace
MailChimp		
Salesforce		

Slack		
ZenDesk		

This three models' advantages and disadvantage will discuss in another chapter later. Main differences between models are shown by next diagram.



Picture #2: Summary of key differences (source: www.bmc.com)

As may see on picture above, different delivery models require different level of own resources. SaaS model gives the complete solution, where company needs the less in-premises effort. Whereas London Bike Ltd interest in Software as a Service model, this will discuss in detail in a later chapter also.

2.3. Type of Cloud Computing

So far Cloud Computing was reviewed in aspect of function or operation. There is another angle as cloud services could been looking. This is class service by users. Cloud

services offer bunch of IT services, depends of user`s organisation needs. From user side there are not many differences: switch on device, click on your software and usually ready to work. From management side there are many differences like location of cloud, maintenance of cloud, security of cloud etc. When an organisation manages its own cloud in the same premise, it`s a private cloud. When an organisation uses a cloud services, which locates out of its premise and pays after the use, it`s a public cloud. Borders between public and private clouds have mashed recently. Hybrid cloud, what is combination of private and public cloud, make it clear. To recognise a cloud type, need to check first: where is the cloud hardware, who runs and maintains them, which group of users can reach the cloud and from where they can access it. Look now what Microsoft say about this topic:

- *“Public clouds are the most common way of deploying cloud computing. The cloud resources (like servers and storage) are owned and operated by a third-party cloud service provider and delivered over the Internet. Microsoft Azure is an example of a public cloud. With a public cloud, all hardware, software, and other supporting infrastructure is owned and managed by the cloud provider. In a public cloud, you share the same hardware, storage, and network devices with other organizations or cloud “tenants.” You access services and manage your account using a web browser. Public cloud deployments are frequently used to provide web-based email, online office applications, storage, and testing and development environments.” (www.azure.microsoft.com, 2020).*
- *“A private cloud consists of computing resources used exclusively by one business or organization. The private cloud can be physically located at your organization’s on-site datacenter, or it can be hosted by a third-party service provider. But in a private cloud, the services and infrastructure are always maintained on a private network and the hardware and software are dedicated solely to your organization. In this way, a private cloud can make it easier for an organization to customize its resources to meet specific IT requirements. Private clouds are often used by government agencies, financial institutions, any other mid- to large-size organizations with business-critical operations seeking enhanced control over their environment.” (www.azure.microsoft.com, 2020).*
- *“Often called “the best of both worlds,” hybrid clouds combine on-premises infrastructure, or private clouds, with public clouds so organizations can reap the advantages of both. In a hybrid cloud, data and applications can move between private and public clouds for greater flexibility and more deployment options. For instance, you can use the public cloud for high-volume, lower-security needs such as web-based email, and the private cloud (or other on-premises infrastructure) for sensitive, business-critical operations like financial reporting. In a hybrid cloud, “cloud bursting” is also an option. This is when an application or resource runs in the private cloud until there is a spike in demand (such as seasonal event like online shopping or tax filing), at which point the organization can “burst through” to the public cloud to tap into additional computing resources.” (www.azure.microsoft.com, 2020).*

2.4. Summarizing of Cloud Computing introduction

After finish viewing all aspect of Cloud Computing, summarize important matters:

- Five main characteristics of cloud service are: On-demand self-service, Broad network access, Elastic resource pooling, Rapid elasticity, Measured service
- Three delivery models are: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS)
- Three type of cloud service: Private Cloud, Public Cloud, Hybrid Cloud

By finished introduction of different models and type look through what are their benefits or non-benefits for a company.

3. Advantages and disadvantages of Cloud Computing

In the same order look a list about advantages and disadvantages of models and type of cloud. It based on experience, what were ease and difficulties to companies during installation and running of a cloud service. Besides lists, this chapter gives a deeper look into services.

3.1. Software as a Service

Software and related applications and data are located centrally, and users access them through a web browser. This software is ordered to be a web-based, on-demand service. As it is web delivery model, IT staff does not need to install and update any applications on each individual workstation. In this model, cloud service provider manages all possible technical issue, such as data, server, storage. Important a wide-bandwidth internet connection, what may provide a third party.

3.1.1 Advantages of SaaS

- *“Easy to use – Most SaaS applications do not require more than a web browser to run*
- *Cheap – The pay as you go pricing model of SaaS makes it affordable to small businesses and individuals.*
- *Scalability: SaaS application can be easily scaled up or down to meet consumer demand. Consumers do not need to worry about additional computing infrastructure to scale up.*
- *Applications are less prone to data loss since data is being stored in the cloud.*
- *Compared to traditional applications, SaaS applications are less clunky. They do not require users to install/uninstall binary code on their machines*
- *Due to the delivery nature of SaaS through the internet, SaaS applications are able to run on a wide variety of devices.*

- *Allows for better collaboration between teams since the data is stored in a central location.*
- *Velocity of change in SaaS applications is much faster.*
- *SaaS favors an Agile development life cycle.*
- *Software changes are frequent and on-demand. Most SaaS services are updated about every 2 weeks and users are most time unaware of these changes”*

3.2.2 Disadvantage of SaaS

- *“SaaS software may not be as robust (functionality wise) as traditional software applications due to browser & network limitations.*
- *Having all a user’s data sit in the cloud raises security & privacy concerns. SaaS providers are usually the target of hack.*
- *Attack detection, malicious code detection.*
- *In the rare event of a SaaS provider going down, a wide range of dependent clients could be affected.” (Watts, Raza, 2019).*

3.2 Platform as a Service

In this model a provided platform and environment let developers to design applications and services over the internet. PaaS itself is hosted in a cloud and users access it through a web browser. These applications called middleware. Environment delivers by cloud service provider, so installation, malfunction, storage and updates are not belonging to IT staff.

3.2.1 Advantages of PaaS

- *“Simple, cost-effective development and deployment of apps*
- *Highly available*
- *Developers can customize apps without the headache of maintaining the software*
- *Significant reduction in the amount of coding needed*
- *Automation of business policy” (Watts, Raza, 2019)*

3.2.2 Disadvantages of PaaS

- Risk of getting locked into cloud provider company`s industry standards: lost development options and capability to integrate data and application out of cloud
- Pay-per-use: check best market price, consider pre-paid option because usage per unit could grow up very quickly
- Security: company use own`s application, but data hosted by a third-party vendor is always is a risk

3.3 Infrastructure as a Service

IaaS is a fully self-service for an entire virtualized network solutions such as servers, computers, accessing, storage by the internet. Users have full control over this infrastructure. Company may have own servers and storage in same time.

3.3.1 Advantages of IaaS

- *“The most flexible cloud computing model*
- *Easy to automate deployment of storage, networking, servers, and processing power*
- *Hardware purchases can be based on consumption*
- *Clients retain complete control of their infrastructure*
- *Resources can be purchased as needed*
- *Highly scalable” (Watts, Raza 2019)*

3.3.2 Disadvantage of IaaS

- Providers changing is difficult
- Service availability and security extremely depends on cloud provider
- Maintenance and upgrade are an issue for IT staff
- Location of provider`s server may concern some security issue

3.4 Advantages and disadvantages of private, public and hybrid cloud

Public cloud always provides by a third party. They have full control over the cloud, means they organises security process. Anybody, from anywhere can has access to a public cloud. This access could be by a non-secure way, what gives opportunity to hack or leak data`s. Community cloud is special type of public cloud, where access is limited for a group of users or organisation. Community cloud can be running by the community`s organisation (on-premise type) or by third party (outsourced type). Identify a hybrid cloud is very difficult, because hybrid cloud is a combination of different type of clouds (private, public, community). So, characteristic of hybrid cloud is based on what kind of clouds form it. Main benefit of community cloud is the better security, compares with a public cloud. It is low-cost model like public cloud. Community cloud has a feature to share different responsibilities and tasks among the community`s organisation, helps collaborative works simultaneously. Hybrid cloud has less level of complex security than public cloud, however some parts of hybrid cloud could be well-secured. Hybrid cloud is usually containing private and public clouds, so managing and maintaining a hybrid cloud is more difficult than running an only private or public cloud itself. SLAs

are strict and rigorous. For a clean view of benefits and drawbacks of different type of clouds see Picture #3 below.

 Public Cloud	 Private Cloud	 Hybrid Cloud
No maintenance costs	Dedicated, secure	Policy-driven deployment
High scalability, flexibility	Regulation compliant	High scalability, flexibility
Reduced complexity	Customizable	Minimal security risks
Flexible pricing	High scalability	Workload diversity supports high reliability
Agile for innovation	Efficient	Improved security
Potential for high TCO	Expensive with high TCO	Potential for high TCO
Decreased security and availability	Minimal mobile access	Compatibility and integration
Minimal control	Limiting infrastructure	Added complexity
Benefits		Drawbacks

Picture #3: Key benefits and drawbacks of cloud computing types (source: www.bmc.com)

4. London Bikes Ltd overview

After discussing many aspect of Cloud Computing time to select the best option to London Bike Ltd. To make the right decision first need to know company exist facility. As description said London Bike Ltd host a webpage and they have database management system for clients account, billing, data and orders. In addition, they run an application for payroll system. Altogether there are three main issue: webpage, client database, payroll system.

4.1 London Bike webpage

The running webpage – probably – a static webpage, which means webpage delivers contents to user as it stored, visitors cannot interact with the company. In this case this static website easily migrates to be cloud-based. Cloud server delivers same services, processes will differently depend on company needs. From this point London Bikes site will host in the cloud not in a server. It gives opportunity to improve to dynamic webpage current one.

4.2 Client database

Many providers offer service to host a database. It means current database transform to a cloud one. These providers usually have database templates, which has easily tailor to needs of company who joining cloud service. New database will have features such as elasticity, scalability, redundancy, lower cost, ability to support all datatype, high availability.

4.3 Payroll system

There are lot of cloud-based payroll system in market now. These system has ability to store programs and data for remote user. Payroll software's is included with these system, helps to calculate regularly paid.

5. Recommended solution to London Bikes Ltd

Considering what reviewed previous section, recommend solution is a Software as a Service model for London Bike Ltd. Reasons are follows: for both three key issue has existing solution. By SaaS service, there is an opportunity to improve webpage to dynamic site and possible to connect with client databases. With this improvement client can do self-service activities, they could monitor their account in 24/7. As mentioned above SaaS provide wide range access from any kind of device, so makes all employees life easier to reach corporate information from anywhere at any time.

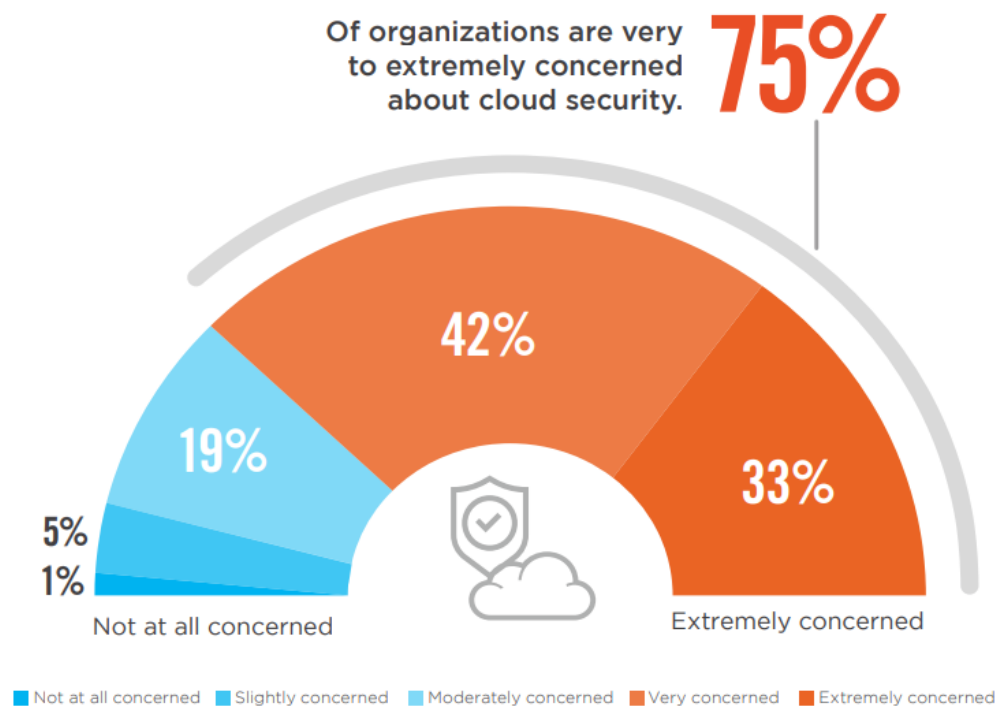
5.1 Considering issues

Best solution always a private cloud, which means only employees have access to network, it delivers more secure solution. In case of client database connected with webpage, some part of system will go in a public cloud. It is necessary if clients have access. May it give less security, but a hybrid type cloud would be a solution. It is possible to limit client's access and possible to separate this part of cloud to make more secure confidential and sensitive data such as client's personal data or payroll system itself. To make a responsible decision look statistics below about security of Cloud service from Cloud Security Report 2020 by Cybersecurity Insider.

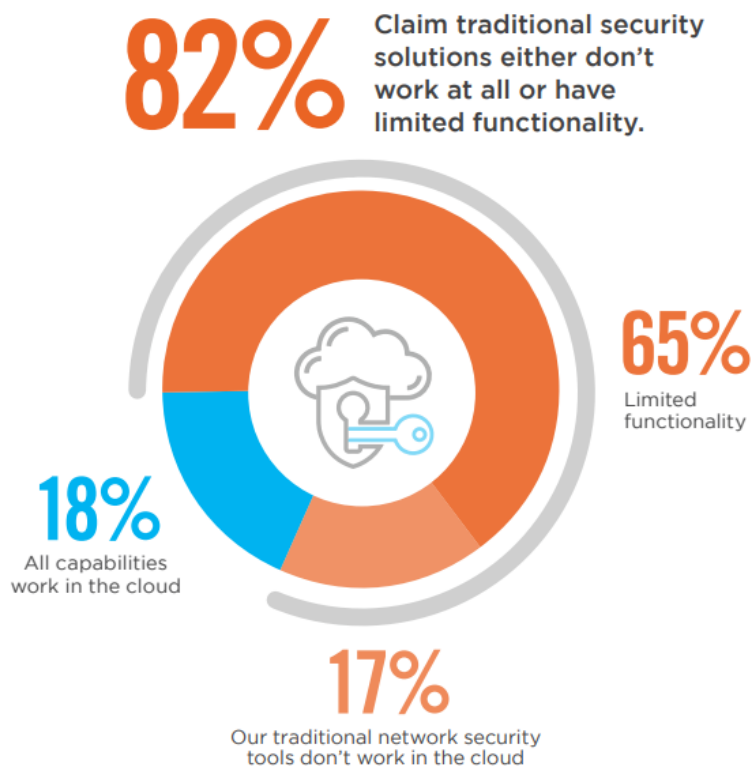
"This 2020 Cloud Security Report has been produced by Cybersecurity Insiders to explore how organizations are responding to the evolving security threats in the cloud and the continued shortfall of qualified security staff." (Cybersecurity Insider, 2020)

- *"Security remains a key issue for cloud customers, despite continued rapid adoption of cloud computing.*
- *75% of cybersecurity professionals confirm they are very concerned about public cloud security, a small increase from last year's cloud security survey.*
- *When asked about what are the biggest security threats facing public clouds, organizations ranked misconfiguration of the cloud platform (68%) highest, up from the third spot on last year's survey. This is followed by unauthorized access (58%), insecure interfaces (52%), and hijacking of accounts (50%).*
- *Among the key barriers to cloud adoption, organizations mention a lack of qualified staff (37%) as the biggest impediment to faster adoption – up from the fifth spot on last year's survey.*
- *When selecting a cloud security provider, most organizations look at cost-effectiveness (63%), ease of deployment (53%), and that the security tools are cloud-native (52%) as their key priorities.*
- *When asked what criteria organizations consider most important when evaluating a cloud security solution they prioritize product features (66%), cost (65%), and vendor experience (55%) as the most important considerations.*

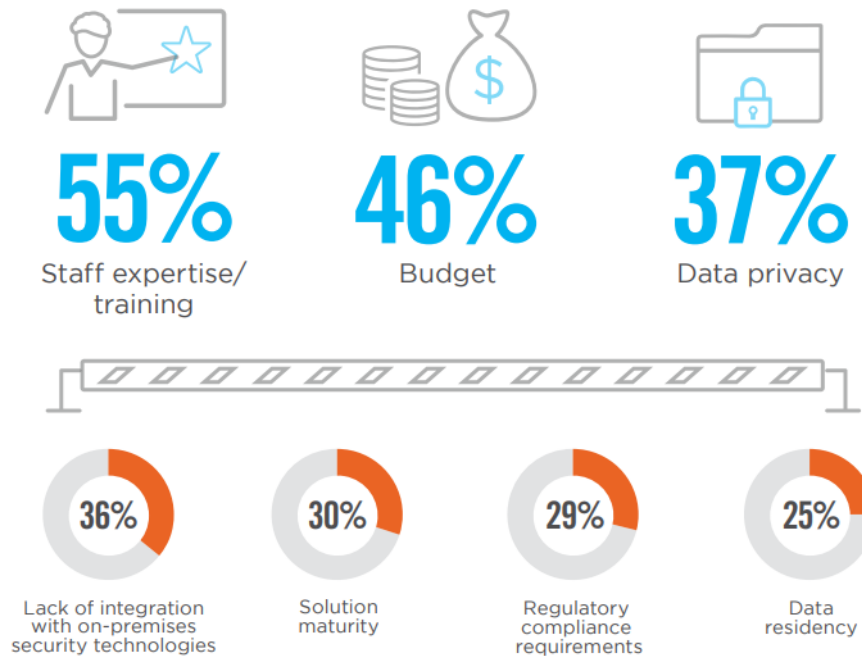
- Organizations rely on multi-cloud solutions with most organizations deploying more than three cloud solutions in their environment.” (Cybersecurity Insider, 2020)



Screenshot #1: How concerned are you about security of public clouds? (source: Cybersecurity Insider, 2020)

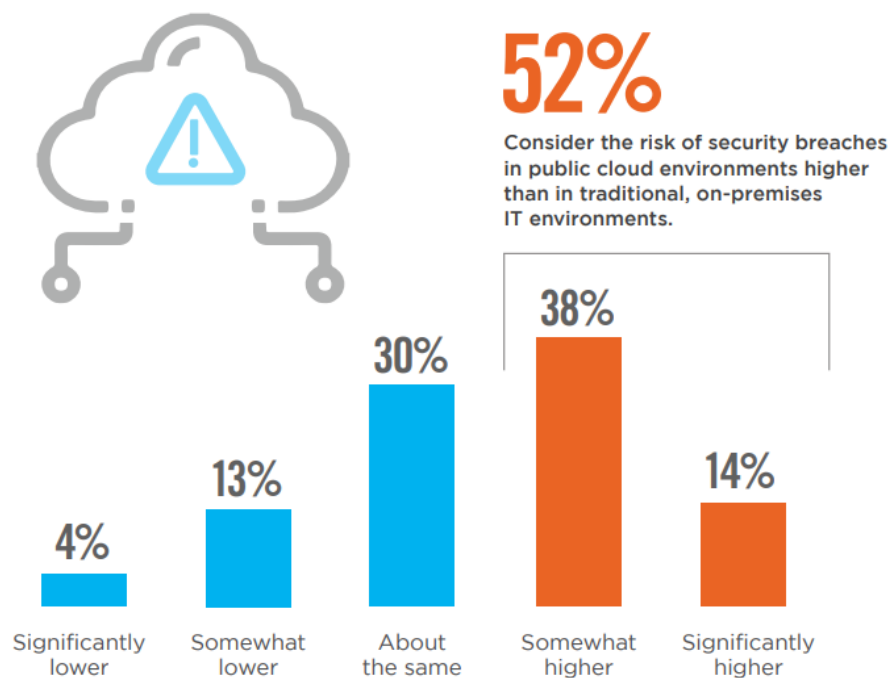


Screenshot #2: How well do your traditional network security tools/appliances work in cloud environments? (source: Cybersecurity Insider, 2020)



Sunk cost into on-premises tools 24% | Integrity of cloud security platform (DoS attack, breach) 17% | Limited control over encryption keys 15% | Scalability and performance 12% | Not sure/other 10%

Screenshot 3#: What are the main barriers to migrating to cloud-based security solutions? (source: Cybersecurity Insider, 2020)



Screenshot #4: Compared to traditional, on-prem IT environments, would you say the risk of security breaches in a public cloud environment is ... (source: Cybersecurity Insider, 2020)

May these diagrams be not convincing, but look the provider side, what they said about security. Cite Sean Roche, Associate Deputy Director of Digital Innovation, CIA, from AWS Public Sector Summit Keynote: “The cloud on its weakest day is more secure than a client-server solution. It’s been nothing short of transformational. It has transformed our ability to build new capabilities.”

5.2 Possible solution for security

Refer to Cybersecurity Insider security report, security seems a risk. Unfortunately, many companies continue to spend huge amounts on blackmail virus makers instead of improving their cybersecurity protection. Recently the situation is better than was. Thanks to more and more company realized the importance of security. Most of providers use already CIA security model. (CIA stand for Confidentiality, Integrity, Availability) This policies are the most important element of network security. Cloud service is based on connection between cloud and users. If this connection secure, the cloud is secure, because servers what host cloud are already secure for a while. However, cloud security is improving last few years a Virtual Private Network (VPN) could be very useful. It is encrypting traffic between cloud and users, so minimize risk of attack.

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