Cost Optimization of Top Three Cloud Services Google, Azure and AWS using HybridCloud

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Abstract:
The process of reducing your overall cloud spending by using your own available resources as add-onsfor the cloud infrastructure you are using for your business is Cloud cost optimization.This paper discusses the benefitsin terms of cost of applying distributed cloud computing technologies in the development of business. First, the conception of cloud computing is introduced, and then a hybrid cloud computing platform for business is designed.The distinguished characteristics of the proposed platform are then explained in detail, followed with the introductionto the new system of storage using remote hardware infrastructure and resources. An introduction to state-of-the-art products which can be used to build the proposed platform is given.

Keywords: Cost optimization, cloud, remote hardware, infrastructure models, reverse billing method, AWS, Google Cloud, Microsoft Azure, Lambda, API Gateway.

1 INTRODUCTION

The gateway to a shared database of computational services is cloud computing. It allows customers to reduce prices, minimise managerial obligations and improve market flexibility. This will be the factor that is now becoming a mainstream model, and progressively more businesses are turning into cloud computing approaches. There are some benefits, but, as a modern model, there were still some difficulties or underlying challenges. [1]

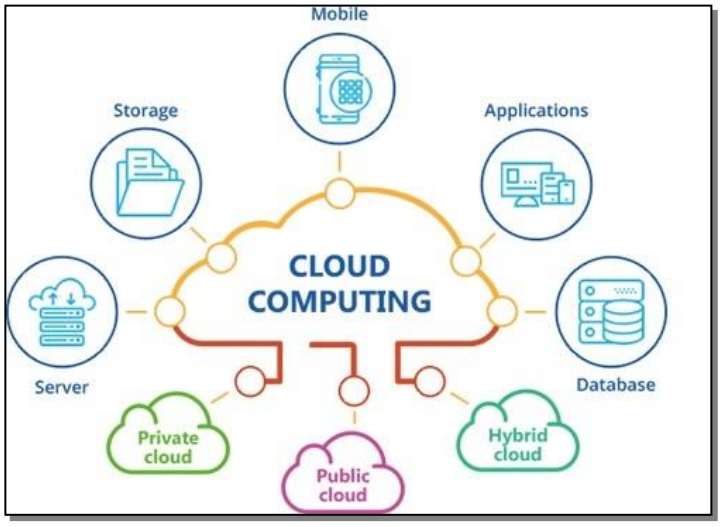

Figure1: Cloud Computing Services and Deployment Models

The National Institute of Standards and Technology (NIST) provide an operational concept of cloud computing as follows:

Cloud computing is a paradigm for enabling convenient on-demand internet access to the centralized

network of customizable computing facilities (e.g., networks, servers, storage, applications, and services) which can be quickly configured and distributed through limited communication or network operator interdependence. This cloud architecture comprises five basic features, three distribution models, and four deployment models that foster availability.

The five essential characteristics are:

1. On-demand self-service
2. Broad network access
3. Resource pooling
4. Rapid elasticity
5. Measured service and

The four deployment models are:

1. Public cloud
2. Private cloud
3. Hybrid cloud
4. Community cloud. [2]

The process of reducing your overall cloud spending by using your own available resources as add-ons for the cloud infrastructure you are using for your business is Cloud cost optimization. The advantages of using distributed cloud computing technology in the growth of businesses are described in this article in respect of value. The principle of cloud infrastructure is adopted first, followed by creating a hybrid cloud computing model for the enterprise. The unique features of such a model platform are then detailed defined, supported by a reference to a modern storage device that utilises external hardware resources. At last, an overview of cutting-edge products that could be used to develop the suggested platform is given.

2. THE ECONOMICS OF CLOUDWARE

As cloud infrastructure develops, the administration is placing a stronger focus on considering market gains through cloud investments. Cloud computing will be greater than a market enabler and cost-cutting practice around the application framework landscape; it will be an innovation in capacity building securitized to push the company, with improved adaptability, versatility, stability, usability, and efficiency. IT will move on its journey to commoditization as technologies and creative market models mature. The majority of methods rely on cost optimization, which is analyzed utilizing expense estimates related to resource use to create a business case for the cloud-primarily interpreted by operating efficiencies.

2.1 CLOUD COMPUTING IN ENTERPRISES – THE DRIVERS

The cost efficiency improvements realized as a part of an amount of change from CapEx (capital expenditure) to OpEx (operating expense), TCO (total cost of ownership), and, at best, aiming at ROI (return on investment) and NPV (net present value) seem to be the indicators and calculations related to cloud investment that have been utilized (particularly by SMEs). [3]

Conventional IT companies invest in infrastructure properties such as hardware and software technology, which necessitates a financial outlay. There are specific concerns associated with capital expenses:

- Money is a finite resource, particularly in government service and small businesses, and it must be utilized wisely.
- CapEx creates an obstacle to entering the market by causing it challenging to reach cutting-edge technologies, particularly for SMEs.
- Big improvements in external IT hardware and software limit market versatility and resilience, and there is a possibility of provider lock, particularly for large businesses..

2.1.1 Total Cost of Ownership (TCO)

TCO is an investment indicator that considers both direct and indirect costs of technological up-gradation and service throughout the life span of an IT project. Anything from the basic hardware and software

purchase to implementation, management, training, repairs and enhancements, operation and assistance, protection and disaster restoration resources, and all similar operating expenses are included in the costs. Anallocation of these costs is illustrated in Table 1.1.

IT Cost Components		
Direct Costs	**Indirect Costs**	**Overheads**
Server	Network	Facilities
Storage	Storage	Power
Software (application)	Software (infrastructure) labor (operational)	Bandwidth
Implementation	Maintenance and upgrades, Support, Training	Labor (admin)

Table1:An allocation of IT costs

Figure 2: Total Cost of Ownership

The following is how the baseline TCO is calculated:
Both market and technological expense sources should be identified. Costs may come from a variety of places, including computing power, network traffic, and storage.
Include an expense that is not visible. Unlike in-house provisioning, which has hidden costs such as additional administrative headcount, different assets and facilities needs, unavoidable overprovisioning and added expenses for maintaining redundancy, cloud provisioning has associated fees like service interruptions, inappropriate service scaling, mismanagement or a denial of service (DoS) attack, and additional charges for maintaining duplication.
It is essential to assess the application profiles and service combinations. Applications use computational power at different speeds. Others do a limited number of calculations over a large amount of data and are often more computing-intensive.

- Measure the TCO under a variety of device configurations to get a better understanding of values during various loads.

- It is necessary to assess the function of load variation. It's critical to pinpoint the times and patterns of application that necessitate heavier loads or load variance.

2.1.1.1 Calculation of Cost–Benefit Ratio

The total benefits that are obtained from an investment over the costs consumedto deliver these benefits is calculated by this method:
Costbenefit ratio = Total benefits /Total costs

2.1.1.2Calculation ofProfitability Index

The profitability metric uses a ratio and tries to figure out the correlation between the project's expenses and profits.
Profitability index = Present value of cash flows / Investment
The profitability metric must have a minimum level of 1.0; any level just under 1.0 indicates that the project's current value is lower than the original expenditure. The financial competitiveness of the planned project improves as the feasibility index values rise.

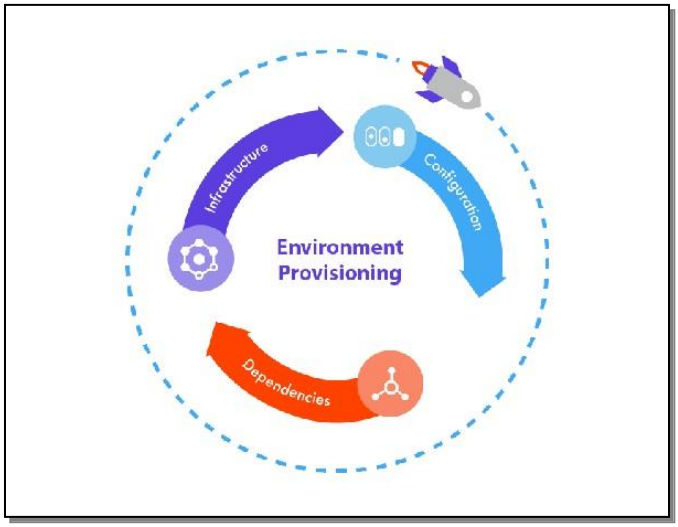

Figure 3: Environment Provisioning through Configuration.

2.2 PROVISIONING CONFIGURATIONS

An object in the domain that contains information aboutthe cloud platform is a cloud provisioning configuration. The Data Integration Service the information that is required to create a cluster on the cloud platform is given by the cloud provisioning configuration.

2.2.1 Traditional Internal IT

In the standard internal IT model or zero-outsource concept, all IT programme or product elements are acquired and handled using available assets. Office IT network is the prevalent kind. An ISP is provided and linked to the organizational network (Intranet) through a modem in several corporate offices. Firewalls, routers, centralized file and fax servers, personal devices and possibly a cellular network and laptops are installed on this internal framework. These devices, and specific office software, are purchased, installed, and operated by the IT department. IT for more advanced enterprise systems may be done similarly, with customized or packaged programs mounted into specially provisioned hardware.

2.2.2 Colocation

Another option for installing software is to use a co-location network, which is a third-party data centre. In this design, the corporation is also accountable for buying server hardware and designing or buying the necessary software for the system to run. The co-location centre delivers electricity, conditioning, rack space, and network access for the third party's devices. Network redundancy, backup control, and physical protections are all provided by the co-location centre.
Annual agreements with an initial service fee and monthly payments depending on the volume of rack storage (usually coupled with a fixed allowance of power) and dedicated bandwidth are obtained for offsite location.

2.2.3 Managed Service

The corporation no longer imports server and operating systems under the managed system in parallel to outsourcing network topology, including energy and web accessibility. The maintained supplier leases these to the business and also contains the software and computer system applications. As part of the operational package, the vendor can also rent basic applications like databases and simplistic database maintenance products.

2.3 QUALITY OF SERVICE (QoS)

The potential of a cloud service to reply to anticipated requests and deliver those at a level that meets its vendor and its clients' needs pointed to as Quality of Service (QoS). Continual process efficiency, connectivity, and high accessibility are consistency drivers that embody consumer preferences. They become critical to a business's competitiveness and viability because they could significantly affect service delivery.

2.3.1 Service-Level Agreement (SLA)

Organizations rely on corporate divisions, suppliers, and external network vendors to offer facilities. They are using service level agreements (SLAs) to ensure that the right service provider has a guaranteed level of service quality. The Service Level Agreement (SLA) is a structured arrangement between a supplier and a customer that formalizes the specifics of a Service (content, price, distribution process, approval level, quality requirements, and penalty to be applied in case of non-compliance, typically in qualitative terms) in a manner that satisfies when both supplier and the customer requestor's shared agreement and aspirations.

Figure 4: SLA between the provider and client

The SLA contains the following fields:
Purpose: The sector determines the meaning behind the formation of the SLA.
Parties: This area identifies the participants to the SLA and their positions, such as the service vendor and the service user (client).
Validity period: This field specifies how long the SLA will be valid. The agreement term's start and end times are used to define this.
Scope: This area specifies the contract's range of services.
Restrictions: This area specifies the steps that must be followed in an attempt to provide the desired service standards.
Service-level objectives: This area specifies the service standards that all consumers and operators negotiate on, and it also provides several service-level metrics such as capacity, efficiency, and reliability. There will be a target level for any of these facets of the service level that must be met.
Penalties: This area specifies what penalties can be applied if the network operator performs poorly and fails to fulfil the SLA's objectives.
Optional services: This area lists any services that are not usually needed by the customer but may be necessary for the event of an exception.
Exclusion terms: These define what the SLA does not cover.
Administration: This sector determines the corporate authority for managing the procedures and smart objectives of an SLA**.** [4]

3. CLOUD DEPLOYMENT MODEL SCENARIOS

A Decentralized Cloud is a public cloud hosting system that allows users to operate public cloud services in various sites, either on in other cloud providers' data centres or third-party computer servers or co - location centres, and handle it from a centralized control layer. (5)
According to NIST, there are four types of cloud network architectures: public cloud, private cloud, group cloud, and hybrid cloud. A cloud deployment model is characterized by whether the deployment's network is located but controls the architecture. "What deployment model can you use?" is the most critical cloud deployment decision you'll create.
Every cloud implementation design caters to a particular set of operational requirements, so you must select one that meets your needs. Each cloud implementation design seems to have a unique value strategy and related costs, which would be a much more critical consideration. As a result, in many ways, deciding on a cloud application model is purely a financial decision. In any situation, you must be mindful of the features of each setting in needed to create an accurate conclusion.[6]

3.1 PUBLIC CLOUD

An organization migrates an application, its data, and its business process onto a third-party cloud service provider’s platform via the Internet is the public cloud deployment.

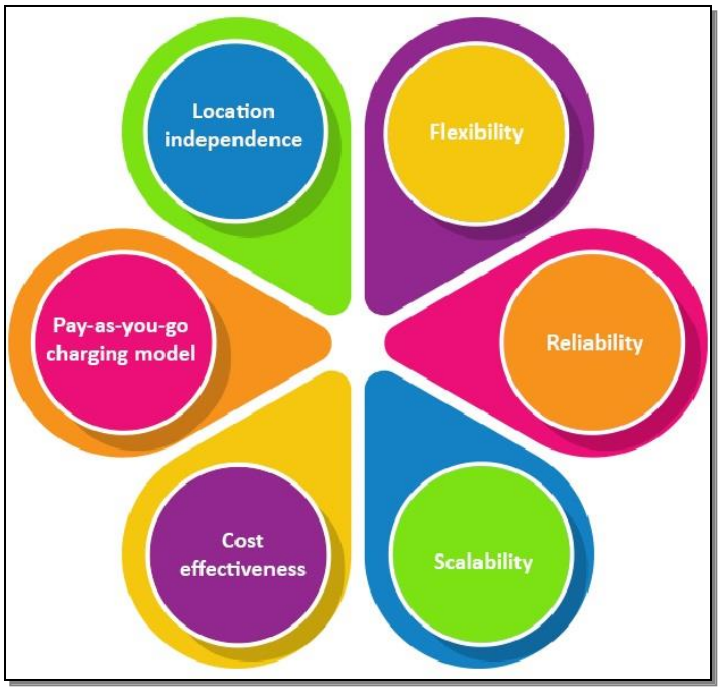

Figure 5: Features and Benefits of the Public Cloud Model

It's a great option to get started with cloud computing in a cost-effective, scalable, and quick-to-market manner. Utilizing the numerous cloud services from Amazon, Google, Salesforce, and others to see how the cloud could bring to the business is a unique way to test the potential.
The following are some of the explanations why a company could start its cloud computing journey with a community cloud infrastructure.

The price is low. Public clouds provide a reduced entrance into cloud computing by supporting a proof-of-concept (POC) or demonstration project with modest research and development (R&D) financing.

A wide range of cloud solutions is available. From virtualization and cloud operating system (OS) or application systems through Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) offerings, a wide range of cloud-enabled capabilities are available to integrate into complete cloud applications.
There is minimal risk. With minimum risk exposure, a company will efficiently innovate with cloud computing technologies. Pay just for what you require/use. Public clouds operate on a fully adjustable utility expense model, which allows you to avoid charging the payments after the original project is finished or if you no longer use the cloud resources.
Accumulation of information, expertise, and practice in a short period of time. The public cloud is a fast way to acquire insight, expertise, and expertise in the evolving technology movement in cloud computing. Using public clouds allows the company to benefit from the knowledge and expertise of a third-party cloud service vendor. This is a huge strategic benefit for any company looking to the market for a cloud computing approach.

3.2 PRIVATE CLOUD

Private cloud integration situations are when a company deploys cloud services to its network, or Intranet, behind its security firewalls, allowing the company to experiment with cloud technology without risking

revealing or transferring its data or software outside of its own internal and organizational security controls.
The following are some of the reasons why a company could start its cloud computing initiative with a private cloud implementation model:
Protection and safety: You can avoid concerns over privacy and security by keeping data behind your firewalls.

It preserves strategic opacity such that your opponents are unable to deduce your intentions.

First and foremost, concentrate on internal optimization: maximize the internal use of network properties.

Become an internal cloud service provider for the enterprise: The opportunity to become an internal cloud service provider will start and accelerate with a private cloud strategy. This is a significant advantage of starting the infrastructure project from the ground up with a personal cloud implementation model.

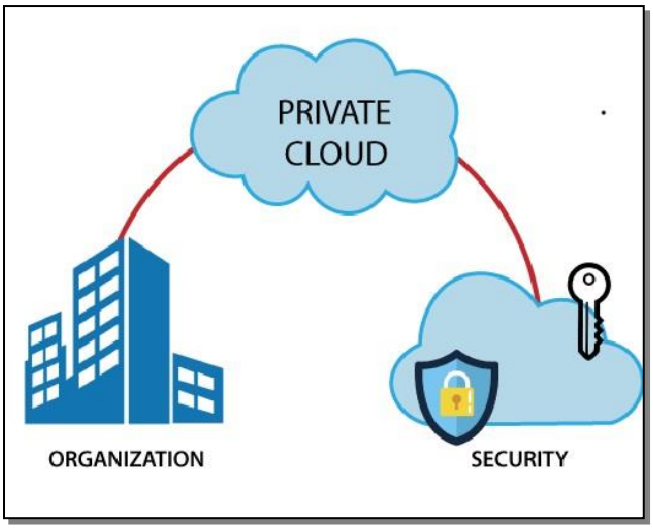

Figure 6: Private cloud is much secure

3.3 HYBRID CLOUD

Hybrid Clouds combine the benefits of both public and private clouds to solve a broader range of operating usage cases and industry scenarios. For example, an enterprise might use personal cloud capabilities to federate two data centres to maximise the utilisation and availability of the server, computing, and network resources, while simultaneously using Amazon's public cloud capabilities to deliver a new product or service via Amazon's e-commerce storefronts. To meet this criterion, the hybrid cloud combines different cloud patterns.

The following are some of the reasons why a company could start its cloud computing initiative with a hybrid cloud implementation model:

Start with the end goal. Your cloud launch point supports the end state of cloud infrastructure, a hybrid cloud implementation. Most market experts believe that in the future, only hybrid clouds can exist.
A variety of cloud-based solutions are available. Hybrid clouds have a wide range of solution options that solve business models and problems that we can only dream of right now. Why not start with hybrid clouds to gain a deeper understanding of the cloud's true potential in the long run? There's no need to put

limitations on the learning experience right now. Hybrid clouds will help you do that..

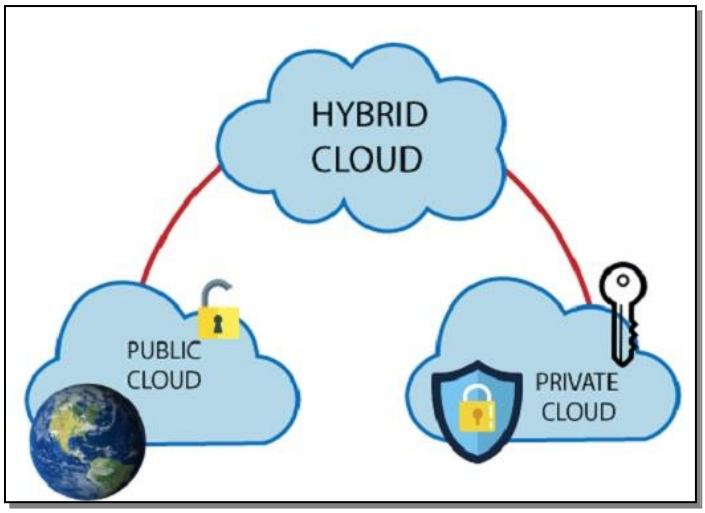

Figure 7: Hybrid Cloud

Examine market models that are built on the cloud. Hybrid cloud allows you to experiment with and develop new market models that take advantage of the convergence of private and public cloud use situations. Via alternative pathways to market and new delivery structures with internal operations across the expanded value chain, you can genuinely pursue business model creativity. Hybrid clouds provide the company with this one-of-a-kind experience.

Extra-enterprise thinking is a way of looking at it from a different perspective. Hybrid clouds promote extra-enterprise thinking in terms of market operations, cloud solutions, and skills. You would be in a great place to innovate your market strategy, operations model, and business processes by integrating cloud applications if you start your cloud project with an expanded enterprise frame of reference.

Information acceleration at the end of the process. Starting with hybrid computing helps the company to practise the cloud end state faster by studying, acquiring skills, and speeding up the information acquisition process, which will help the team in the short and long term. Knowledge of how the cloud will emerge will give you the first-mover edge, and the faster you gain this understanding, the sooner you will profit from that program.

3.4 COMMUNITY CLOUD

The Community Cloud model supports many organizations exchanging computing services that are members of a network; examples are colleges partnering in some fields of study or police forces across a country or state exchanging computing services. Leaders of the group have exclusive connections to a company cloud framework.

4. REMOTE INFRA FOR COST OPTIMIZATION

4.1 THE NEED

The data provided by Forbes.com suggests that the amount of data we are producing everyday is mind-boggling. There are 2.5 quintillion bytes of data created each day at our current pace, but that pace is only accelerating with the growth of the Internet of Things (IoT) and other tech developments. Over the last two years alone, 90 percent of the data in the world was generated. We need more and more storage, bandwidth and processing power to handle this explosion of data. [7]
To deal with the situation, I introduce a new methodology of working with cloud computing services to save cloud service billing amount.

4.2 THE CONCEPT

In our regular working in the offices, we do not turn off our PCs /serversfor the whole day and night in most of the cases.So, why don't we make use of these PCs /Serversfor processing and storage in our cloud account and earn money.

4.3 THE PROPOSED METHODOLOGY

1. In every such PC/server we can create a separate drive/space in our storage device like in my case I created a 50GB free space with drive name x: considering the Windows operating system.
2. I share the x: with my cloud service provider's account via linking my drive endpoint through my public IP, MAC address and drive name.
3. I use a small client application to manage remote side connectivity and troubleshoot the issue of connection.
4. In the above connection I use VPN to make it more secure.
5. Once x: drive connects with cloud service the dashboard show the statistics of drive connection time, space, throughput, bandwidth, latency and other related data.
6. Based on the above parameters, calculate reverse-billing hours/day based.
7. Billing means debit of our billing account and reverse billing means Credit in our billing amount, like solar panel plate we are installing in our house and the electricity board manages both side billing debit and credit and finally gives us the Net Bill (Debit Bill – Credit Bill) at the end of the month.

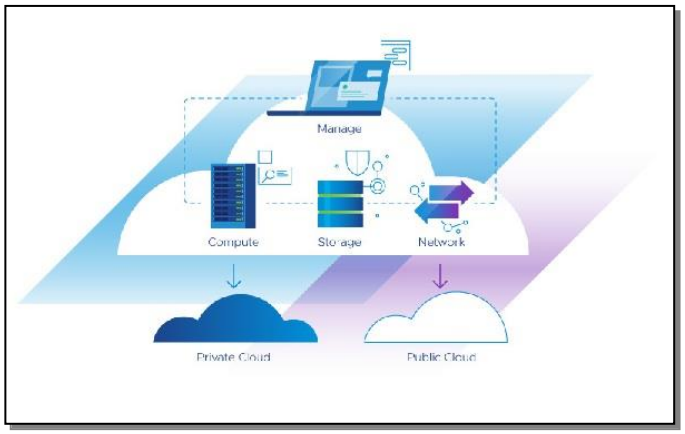

Figure 8: Reverse billing methodology

4.4 BILLING FORMULA

Current month Bill = Total billing cost of public cloud – Total earning through private resources

4.4 USAGE

1. Can be used in storage as volume drive in EC2 instances.
2. The same system can be used in spot instance also.
3. Can use S3, Glacier or such services.
4. Can use in replication of data.

4.5 ADVANTAGES

1. It saves electricity making the system more environment friendly.
2. We can use our PCs /servers capacity in their idle time.

5. CONCLUSION

We should use the resources we have with us to reduce the cloud billing cost in the way of hybrid cloud or fully private cloud, but before using, we should ascertain the availability, security and agility infrastructure. For this, we can categorize our applications/web-sites in different categories like 1) low risk, 2) medium risk and 3) high risk and accordingly we can deploy the application/web-site.

When it comes to selecting a cloud service, there are a number of considerations to weigh, with pricing being one of the most relevant. This analogy would save you thousands of rupees/dollars if your programme is going to be used by millions of users and you are going to use thousands of instances.

Organizations must weigh the full costs of transitioning to the cloud against the potential opportunities gained and the opportunity costs of not doing so. It's always a case of paying a premium for significantly changed, streamlined, or stable IT. As a result, benchmarking costs above an equal amount of internal server capability is critical.

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