![MDS TECHNOLOGIES logo]

SERVICE DEFINITION

UKCLOUD HIGH PERFORMANCE COMPUTE

G-CLOUD 10

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WHY MDS?

- A privately owned, UK sovereign company
- Connected to Internet, JANET, HSCN, PSN, RLI
- Public, community and private cloud available
- Security Cleared technical and customer service staff
- We are Agile, Flexible, Open, Honest and Transparent
- We deliver cost effective solutions on time and within budget
- We are your One-Stop-Shop for secure assured Cloud services
- A fully managed platform using our ITIL-aligned 24/7 Service Desk
- Experienced at delivering small, large and complex Cloud solutions

- We are an SME - large enough to deliver, small enough to care

REDUCING IT RISK AND REDUCING IT OPERATING COSTS

SUMMARY OF SERVICE FEATURES

- Scalable high-throughput compute with large amounts of cores and memory
- Optimised for Grid Engines, High Performance Compute, Massively Parallel Processing
- Choice of virtual CPU mode core-to-memory ratio and node sizes
- Connected to secure UK Public Sector networks
- Secure and highly scalable
- Connected to PSN, N3/HSCN, JANET, RLI, Internet

MDS AND UKCLOUD – THE PERFECT PARTNERSHIP

MDS technologies Limited (MDS) offers a cloud platform provided by the award winning cloud services provider, UKCloud. We have a strong, committed relationship with UKCloud, the market leader in the Digital Marketplace for G-Cloud Infrastructure as a Service, through a long-standing relationship underpinned by a formal partnering agreement. MDS is a reseller, at cost, of UKCloud's cloud and we have resold services since the launch of the G-Cloud framework in February 2012. Services. We have been a UKCloud Partner since their creation in 2011, and became a Preferred Partner in 2016. This status enables us to provide a high level of service to our customers and gain enhanced support from UKCloud.

As a UKCloud Preferred partner, MDS offers true National Institute of Standards and Technology (NIST) cloud services, which are offered as part of a community cloud service only available to the UK Public Sector and secured and managed in line with UK government security classifications.

UKCloud and MDS both utilise pricing models based on transparent charges and "pay for what you use" on an hourly and/or monthly basis.

Service assessment guide

What the service provides

The scale and elasticity of cloud makes it an ideal environment for large-scale compute-intensive workloads such as Grid Engines, High Performance/Throughput Compute (HPC/HTC) and Massively Parallel Processing (MPP), all of which have an enduring requirement for large amounts of processor cores and memory.

UKCloud's High Performance Compute service is designed for these types of workloads. In return for a volume and term commitment for a large number of compute cores, customers get a cost-effective, highly scalable infrastructure.

High Performance Compute leverages the benefits of the UKCloud assured cloud platform, providing you with a trusted cloud platform that's connected to key government networks, such as N3/HSCN for health and social care, and Janet for research and education.

For workloads that require a temporary, more flexible or dynamic service, UKCloud's UKCloud for VMware may be more suitable. It offers exceptional performance and scalability, and consumption-based pricing. We also offer UKCloud for OpenStack, so we can deliver a suite of services to meet all of your needs.

What the service can help you achieve

- Deploy compute-intensive workloads on a massively scalable and inexpensive platform
- Avoid the CAPEX costs, risk and complexity associated with deploying a private infrastructure
- Build hybrid cloud solutions optimised for both compute-intensive workloads or more traditional workloads
- Integrate compute-intensive workloads with systems and datasets located on secure government networks (such as N3/HSCN, Janet and PSN)

Key service capabilities

- Uses a proven hyperscale architecture to deliver predictable performance at scale

- Optimised for the sensitivity of your specific workload via the DDoS-protected internet-facing Assured domain and the trusted Elevated domain

- Offers a choice of virtual machine (VM) sizes to suit the core and memory density requirements of your compute-intensive workload

- Tuned to reflect the inherent resilience provided by your Grid Engine solution

Why UKCloud

- Our multi-cloud platform offers choice, scalability and flexibility for our public sector customers, without locking them into a single proprietary technology stack

- We are UK sovereign, with secure and resilient government-grade UK data centres separated by over 100 kilometres, located in Crown Campus. We give 2% of our pre-tax profits to charity, and our values, beliefs and behaviours are aligned to the needs of the UK Public Sector

- Secure cloud platforms optimised for public sector workloads, fully aligned to the NCSC 14 Cloud Security Principles and subject to regular technical CHECK tests - information security and data governance comes as standard. We're compliant with GDPR/UK DPA 2018 (CISPE certified), the Network and Information Security Directive (NIS) and the new NHS Data Security and Protection Toolkit. These are supported by our wide portfolio of industry and public sector accreditations and certifications

- UK-based telephone service desk providing 24/7 support for P1 critical incidents, and a dedicated UK 24/7 Network Operations Centre (NOC) using industry-leading monitoring solutions on our platform. Access to UKCloud's technical experts including Technical Account Managers, Cloud Delivery Managers, and Customer Success Managers to help customers through the onboarding and ongoing delivery of their solutions – all at no extra cost

- We work with a community of over 240 partners, including Independent Software Vendors, System Integrators and Managed Service Providers, to deliver end-to-end solutions specifically for the UK Public Sector

Cloud characteristics delivered

- Elasticity — genuine private cloud platform that supports the largest, horizontally scaling, compute-intensive workloads; a proven hyperscale platform offering predictable performance

- Self-service — complete autonomy to provision, change and manage your virtual data centre via the UKCloud Portal or using our fully documented UKCloud Portal API

- Measured — a comprehensive SLA, backed by Service Credits

- Broad networking — connect via DDoS-protected internet; a government community network such as PSN, N3/HSCN, Janet or RLI; or HybridConnect, using your own dedicated circuits

- Resource pooling — delivered from an existing multi-tenant platform, leveraging the benefits of UKCloud's assurance, connectivity, automation and scale

Key characteristics of our service

We understand that long-term compute-intensive workloads require a platform that is suitably scaled, has no resource contention, offers flexible core-to-memory ratios, and is delivered at an appropriate per-core-hour price point.

UKCloud's High Performance Compute is designed to meet these requirements, and to provide an easy-to-deploy and easy-to-use infrastructure that can power your Grid Engine or parallel processing workloads.

The service is provided with a variety of cluster-wide options as follows:

- Choice of our security domain. We provide both an internet-connected Assured OFFICIAL domain and Elevated OFFICIAL domain, which is primarily connected to government secure networks

- Choice of network connections. This includes PSN Assured, PSN Protected (including legacy networks such as GSI, PNN, CJX), RLI, N3/HSCN and Janet

- Virtual CPU mode option. High Performance Compute is based on hyper-threaded cores which provide a cost-effective solution for compute-intensive workloads. You can opt for Native mode by using up to half the allocated cores to ensure a one-to-one mapping between virtual CPUs and physical (non hyper-threaded) cores for maximum processing power

- Choice of core-to-memory ratio. All VMs in your compute-intensive cluster must be identically configured based on one of two core-to-memory ratios

As a guide to what's achievable, the table below provides a high-level overview of some of the more common deployment combinations on the UKCloud platform.

Your workload characteristics	UKCloud recommends		
	Security domain	Core-to-memory ratio	Connected networks
Workloads processing particularly sensitive datasets	Elevated OFFICIAL	1 core:12GiB	HybridConnect
	VM and associated data reside in the non-internet-connected Elevated OFFICIAL security domain, providing the highest levels of trust and assurance.	VMs have an uncontended compute (CPU/GiB) resource allocation. Automated rebalancing is disabled to reduce workload movement around the platform, reducing workload disruption.	Connected to higher-security networks such as PSN Protected, legacy government networks (such as GSI, PNN and CJX) and RLI.
Workloads that require connectivity to the internet and other lower-security networks	Assured OFFICIAL	1 core:12GiB	Janet
	VM and associated data reside in the DDoS-protected internet-connected Assured OFFICIAL security domain, providing access and connectivity to lower-security networks.	VMs have an uncontended compute (CPU/GiB) resource allocation. Automated rebalancing is disabled to reduce workload movement around the platform, reducing workload disruption.	Connected to lower-security networks such as PSN Assured, Janet, N3/HSCN and DDoS-protected internet.
	Security domain	Core-to-memory ratio	Connected networks
Workloads that require an especially high core-to-memory ratio	Assured OFFICIAL	1 core:16GiB	DDoS-protected internet
	VM and associated data reside in the DDoS-protected internet-connected Assured OFFICIAL security domain, providing access and connectivity to lower-security networks.	VMs have an uncontended compute (CPU/GiB) resource allocation. Automated rebalancing is disabled to reduce workload movement around the platform, reducing workload disruption.	Connected to lower-security networks such as PSN Assured, Janet, N3/HSCN and DDoS-protected Internet

Standard features

High-performance workloads deployed using High Performance Compute benefit from the following features as standard:

- Comprehensive and personalised support, with no hidden charges. High-performance workloads are often mission critical and require immediate interactive support when issues arise. We are ready to stand shoulder-to-shoulder with you at times of crisis. As standard we include:

  - Award Winning 24x7 support available backed by industry leading SLAs

  - Support on technical design questions from our experienced Cloud Architects who are there to provide advice and guidance

  - Cloud Deployment focuses on ensuring your onboarding to UKCloud is not only a seamless experience, but is informative and builds a partnership from day one

  - A Cloud Delivery team focused on managing your relationship on an ongoing basis through our Technical Account Managers and Cloud Delivery Managers

  - A Dedicated Service Improvement team looking at how we can make the UKCloud service easy to consume and focused based on our customers' needs

Pricing and packaging

High Performance Compute provides long-term, large-scale compute capacity on an effective price-per-core-hour basis. To secure the lowest possible rates, your bills are based on your allocated resources, available in a starter pack of 1,920 cores, followed by blocks of 960 cores.

All VMs/nodes within your High Performance Compute must be identically sized and configured. If you need more flexibility, consider our UKCloud for VMware, UKCloud for OpenStack or Private Cloud for Compute services.

Building your application on UKCloud is easy, and our transparent pricing enables you to clearly understand all the components of your solution and assess the value it offers. Follow these steps to define your solution and calculate the costs:

1. Choose the initial size of your High Performance Compute.

2. Choose the most appropriate virtual CPU mode for your workloads.

3. Choose the core-to-memory ratio that best suits your application.

4. Choose the security domain for your workload to use — the DDoS-protected internet-connected Assured OFFICIAL or the non-internet-facing Elevated OFFICIAL domain.

5. Choose the storage tier for your application.

6. Optionally, choose your OS licensing, such as Windows or Red Hat Enterprise Linux (see the UKCloud Pricing Guide for details). Note that the nature of Microsoft Windows Server licensing, if it is chosen for any VM, means it will be charged based upon the number of cores that have been deployed.

Cluster size and virtual CPU mode				Cluster configuration[1,2] — effective price per core-hour			Security domain	
vCPU mode	**Starter pack**	**Upgrade pack**	X	**1 core:12GiB RAM ratio**	**1 core:16GiB RAM ratio**	+	**Assured OFFICIAL**	**Elevated OFFICIAL**
Hyper-threaded cores	1,920[5]	960[5]		£0.05	£0.065		0%	20%
Native cores	960	480		£0.10	£0.13		0%	20%

Storage[3] (per GiB/per month)	
Tier 0 block[4]	£0.10
Tier 1 block	£0.25
Tier 2 block	£0.10

[1] Maximum configuration per VM applies (currently 48 hyper-threaded or 24 native cores)

[2] Minimum configuration per VM applies (currently 8 hyper-threaded cores or 4 native cores)
[3] Tier 2 storage capacity is included on the basis of 15GiB per 2 hyper-threaded cores and 15GiB per native core
[4] Tier 0 storage is directly attached to the compute host for-fast low latency disk interactions. Customers will be allocated the full disk in a Tier 0 configuration
[5] As UKCloud provide the customer with full access to resources in the cluster, including the resources traditionally reserved for maintenance, under normal operation – if these resources are not required - customers will receive access to any additional cores available within the cluster. Presently 192 hyper-threaded cores in the starter pack configuration and 86 hyper-threaded cores for the upgrade pack.

High Performance Compute includes as standard:

- Virtual firewall

- One production virtual data centre (VDC) and one non-production VDC

- VMware HA (High Availability) protection (only with persistent storage)

- Basic load balancing

- DDoS-protected internet

- Personalised support via Customer Success Managers, Technical Account Managers and a telephone support desk

To model a total cost of ownership, you may also want to consider additional elements, such as connectivity; and service options, such as cloud enablement and cross-domain services.

High Performance Compute is subject to the following:

- The minimum cluster size is 1,920 cores; which can be scaled in blocks of 960 cores

- All VMs within the cluster must exist within a single production VDC and within a single site

- All VMs within the cluster must be identically configured and programmatically deployed with appropriate workload distribution such as a grid engine. This is because the SLA does not apply to availability of individual VMs

- If using Tier 0 storage is configured with two local disks in a RAID 10 configuration. All available storage in the cluster will be allocated to the customer with a 6-month minimum commitment

- If any VMs are deployed with MS Windows Server OS, all provisioned cores must be licensed and will be charged at the current rate (as shown in the Pricing Guide)

- There is a two-year (24-month) fixed-term commitment, which can be continued via a further 24-month call-off contract subject to the standard procedures

- Committed Compute Spend is calculated as the effective hourly cost multiplied by the number of hours in a two-year period (for example 24 x 365 x 2 = 17,520)

- 50% of the Committed Compute Spend must be paid upfront; the remaining 50% will be invoiced equally over 24 months

- Early Termination Fee: if the contract is terminated before month 24, the customer will be liable for the remaining cost of the Committed Compute Spend

- In addition to the Committed Compute Spend, a final balancing payment equivalent to 20% of the Committed Compute Spend will be due at month 24 of the contract. The final balancing payment will not apply in the event that the customer enters into a further two-year (24-month) fixed-term commitment

Connectivity options

UKCloud provides one of the best connected cloud platforms for the UK Public Sector. We offer a range of flexible connectivity options that enable access to our secure platform by virtually any government user community or system. The variety of government, public and private networks is shown in the following diagram:

Connection type	DDoS-protected internet	PSN Assured	PSN Protected	N3	HSCN	Janet	RLI	Hybrid Connect	Crown Connect	Cloud Connect
Standard	FREE	FREE	£250	£250	£220	FREE	N/A	N/A	From £200	From £200
Unlimited	FREE	£2,500	£3,500	£3,500	£3,000	FREE	N/A	N/A	N/A	N/A
Set-up fee	N/A	N/A	N/A	N/A	N/A	N/A	£2,000	£2,000	£1,000	£1,000

Please refer to the pricing guide for all options and details.

PSN Assured: The general-purpose unencrypted Public Services Network. Connected to most central, local and devolved government organisations.

PSN Protected: Encrypted higher-security Public Services Network. Connected to legacy IL3 networks including GSI, PNN, CJX, GSE, GSX and others.

Janet: The UK's research and education network. Connected to all education organisations and research councils.

CloudConnect: Enables customers to establish connectivity to UKCloud-approved public cloud providers through peering exchanges or via private connections.

N3/HSCN: The NHS National Network and its replacement, the Health and Social Care Network. This enables you to connect to all health and social care organisations nationwide.

HybridConnect/CrownConnect: Supports a variety of flexible private connectivity options. Enables connection to Crown Hosting (CHDC) and other third-party facilities.

RLI: A high-security network for defence and industry partners. Connection to RLI is subject to extensive vetting and approval from the MoD.

Purchase scheme – Cloud Credits

Purchase Cloud Credits upfront and redeem them against UKCloud services over a maximum two-year period. This enables you to effectively commit your CAPEX or budget spend in advance, with monthly usage deducted from the balance until depleted.

You can find more details in our pricing guide.

An SLA you can trust

We understand that UK public sector organisations need a dependable service that demonstrates value to stakeholders, which is why we offer one of the best SLAs on G-Cloud. What's more, we back our SLA with Service Credits. If we fall short of our agreement, we'll compensate you with Service Credits.

The table below outlines the SLA and Service Credit details. For more information, see the terms and conditions.

Service level agreement	99.90%
Portal level agreement	99.90%
Availability calculation	Availability is calculated based on processor core hours. This is calculated by dividing the actual number of processor core hours that were available by the potential number of processor core hours that could have been available.
	This is based on the number of hours in the billing month (for example, 744 hours for months with 31 days), excluding any planned and emergency maintenance.
Measurement of SLA	Unavailability applies to processor cores that become unresponsive due to a fault recognised at the IaaS layer or below, that is, the fault is within UKCloud-controlled components, such as the physical host availability, storage, power and internal networking such as physical firewalls and routers.
Key exclusions	The following are examples of what is not covered by the SLA: • Faults within your control, such as client application issues and dependency on individual VMs • Routine failures of individual hosts • Faults within external connectivity providers (for example DDoS-protected internet, PSN, Janet or N3/HSCN) and components colocated at UKCloud • Specific VMs and data using ephemeral storage • Planned maintenance
Service Credit	5% of monthly spend for the affected compute platform

* You will not be eligible to receive a Service Credit if your account has any undisputed payments outstanding beyond their due date or you are in violation of UKCloud's Terms and Conditions including the UKCloud System Interconnect Security Policy (SISP).

Supporting documents and resources

This service definition aims to give you enough information about the service, options and pricing to support your G-Cloud procurement process. The following documents, available on request or from the UKCloud Portal, should provide any additional information you need:

- Service Scopes provide more details about our services; they also cover service options, such as the Mass Transfer Facility and Cloud Enablement

- FAQs for each service aim to answer the most commonly asked questions

- Factsheets provide a high-level description of each service

- How to guides provide step-by-step instructions for specific actions and tasks on the platform, including the use of the Portal and interacting with UKCloud support teams

- Getting started guides help you to get up and running quickly using the UKCloud platform, our Portal and our API

Jumpstart service

Not all customers need a full transition service consultancy package. Sometimes getting value from cloud just requires a few days with a subject matter expert to get the building blocks in place that helps your organisation understand and start consuming cloud services. The UKCloud jumpstart service provides a 4 day package of work to help you get going with whichever UKCloud technology you are planning to use. This is provided at a fixed price of £3,500.

Try before you buy

The nature of this service means a trial isn't available. You're encouraged to trial our UKCloud for VMware or UKCloud for OpenStack services to experience the functionality and quality of the UKCloud service.

The small print

The appendix to this service definition provides a summary of the service terms. For full terms and conditions, refer to the Terms and Conditions document, available from the Digital Marketplace.

Appendix

Ordering and invoicing

The service can be ordered via the G-Cloud Framework and must be supported by a valid purchase order.

UKCloud will issue invoices as follows:

- At point of order for upfront fees and service options
- Monthly in arrears for monthly fees

Payment can be made by direct bank transfer (BACS/CHAPS).

Onboarding

Given the nature of this service, on acceptance of an order, UKCloud will work with the customer to create a detailed plan for the High Performance Compute. This design will formalise the scale and configuration of the solution, such as the initial cluster size, additional storage capacity required and estimated eventual cluster size.

UKCloud will create the customer's Primary Administrator account and send a Welcome Pack which includes the URL for the UKCloud Customer Portal, and the getting started guide.

The customer's Primary Administrator can set policies, create additional user accounts and allocate roles and privileges for users within their project or organisation. Each user can then simply log on and begin using the service (typically within 8 weeks from point of order).

UKCloud has created a number of videos, help guides, manuals and FAQs to help train and instruct users so that they are up and running quickly and easily. These are available within the Knowledge Centre, accessed via the UKCloud Portal.

In addition, you will be assigned a Customer Success Manager (CSM) to provide any assistance required during the first 90 days of the service.

UKCloud also has a large ecosystem of partners who can deliver additional services, such as support and professional services. UKCloud would be pleased to introduce you to the right partner to suit your needs.

Data migration

In many circumstances, UKCloud can help facilitate a bulk migration to the platform using local data import. This is priced on a time-and-materials basis from the UKCloud SFIA rate card.

UKCloud can also help facilitate a bulk migration to the platform using offline data ingest and extraction — please ask UKCloud for details.

Service management

As a cloud service aligned to the NIST definition of IaaS, the service is designed to be self-managed via the UKCloud API or secure online Portal, which provide common service management functionality and address standard requirements.

UKCloud will allocate a Technical Account Manager (TAM) to provide you with an assigned point of contact. The TAM will provide additional assistance with reporting and incident escalation, at all times following UKCloud's ISO20000 certified ITIL-based process framework.

For organisations that require a managed service, UKCloud has a mature and active partner ecosystem that can provide value-added services such as consultancy, training and ongoing custom managed services. UKCloud will be pleased to make an introduction on request.

Service constraints

High Performance Compute includes features such as techniques for reducing the activity of live migration (for example, vMotion); and ephemeral storage, which means that workloads are more likely to be disrupted during planned maintenance activities such as patching and tuning.

UKCloud will not consider an SLA breach until the number of cores available to the customer falls below the number of cores committed to the customer (for example, below 1920 for a starter pack or 960 for an upgrade).

The default mode for DRS is set to manual mode and HA will be disabled.

UKCloud will adhere to the following in terms of maintenance windows:

"Planned Maintenance" means any pre-planned maintenance to any of the infrastructure relating to the service. Planned Maintenance activity may result in periods of degradation or loss of availability depending on the nature of the activity required. In such cases, UKCloud shall provide affected customers with at least fourteen (14) days' advance notice of the Planned Maintenance.

If during Planned Maintenance there is a loss of availability outside the scope described in the planned maintenance notification to the service, an SLA event will be triggered, but excluded from Service Credits.

"Emergency Maintenance" means any urgent maintenance required to prevent or mitigate against any event compromising the infrastructure relating to the service. Whenever possible, UKCloud shall: a) provide affected customers with at least six (6) hours' advance notice and b) carry out the emergency maintenance between the hours of 00:00 and 06:00 (UK local time) Monday to Sunday or between the hours of 08:00 and 20:00 (UK local time) on Saturday, Sunday and bank holidays unless there is an identified and demonstrable

immediate risk to customer environment(s). Emergency Maintenance may result in periods of degradation or loss of availability depending on the nature of the activity required.

If during Emergency Maintenance there is a loss of availability to the service, an SLA event will be triggered. This time will be excluded from the availability calculation but will be included in monthly service reporting related to the service.

Technical requirements

Customers will require a workload management tool (for example, Grid Engine) that can distribute a workload across multiple VMs within the cluster, and can automatically recover from the failure of individual VMs.

VMs must be identically configured and programmatically provisioned — for example using a configuration management tool such as Puppet, SaltStack or similar.

Customers will require appropriate network connectivity such as DDoS-protected internet access or accredited connectivity such as a government secure network to our platforms. Connectivity via the DDoS-protected internet, a government secure network (PSN, Janet, N3/HSCN or RLI) or private leased line is available but may incur additional charges if the hosting of CPE routers is required — see the pricing section for more details. Where they are required, customers are responsible for procuring and managing appropriate devices or software to meet the requirement for data security over the various forms of connectivity.

Customer responsibilities

The service is optimised for stateless VMs/nodes that can tolerate sudden unavailability. It is the customer's responsibility to ensure workloads can continue to be processed should individual VMs become unavailable or unresponsive.

The control and management of access and responsibilities for end users including appropriate connectivity, security and accreditation if required. If access is required over government secure networks such as N3/HSCN, Janet, RLI or PSN (including legacy networks), the customer is responsible for adhering to the relevant Code of Connection (CoCo) and for providing evidence of their CoCo to UKCloud upon request. UKCloud is unable to provide access to secure networks where such evidence has not been provided by the customer.

Management configuration and administration of layers above the IaaS (OS patching, application performance monitoring, user administration).

As a core benefit of the cloud platform, customers are able to self-manage their environment including provisioning, stopping/starting virtual machines, antivirus and patching which UKCloud support with the availability of update repositories for key operating systems.

Customers must be aware of the variable nature of the billing based on usage, such as additional storage, bandwidth consumed and licensing.

The customer is also responsible for ensuring only lawful data that supports the UK Public Sector is stored and processed by applications on this environment, and that they fully comply with the UKCloud Security Operating Procedures (SyOPs) and other information assurance requirements as specified in the UKCloud System Interconnect and Security Policy (SISP) and associated accreditation documentation sets.

Termination

Terms

This Agreement is provided on the basis of a fixed term of 24 months. You may terminate this Agreement by providing UKCloud with advance notice in writing of not less than 30 days and paying the associated early termination fee.

At the point of termination, you are responsible for removing all Content by 23:59:59 on the Effective Date of termination. If Content is not removed by this time We reserve the right to charge for any Content not removed, or for retrieving and returning your content, and may destroy or otherwise securely dispose of any of Your Content in Our possession.

Offboarding

Customers are responsible for extracting their own data from the platform if required.

UKCloud may make an additional charge for transferring data out of the service.

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