![ukcloud]

Running Legacy and Enterprise Applications in the Cloud

UKC-GEN-134

OVERVIEW

The UKCloud Blueprint 'Characteristics of cloud applications' discusses the fact that, although many legacy and enterprise applications work in the cloud, only cloud applications are truly designed for the cloud.

This Blueprint looks at the other side of the coin, describing how organisations can run legacy and enterprise applications in the cloud and take advantage of the improved agility and reduced costs associated with cloud solutions.

LEGACY, ENTERPRISE AND CLOUD APPLICATIONS

The benefits of cloud computing are most likely to be realised when organisations run applications that can dynamically and automatically control the underlying environment.

However, this capability is rarely found in legacy and enterprise applications, which is why they typically run in a relatively static cloud environment. This means that organisations don't benefit from elasticity, and can't realise the cost savings that come from releasing cloud resources when they're not required.

At this point, it's worth defining what we mean by legacy, enterprise and cloud applications:

- Legacy applications. Typically, bespoke applications that have been developed by or for the organisation and use legacy application architectures such as mainframe, client/server or similar. These applications are often large and monolithic.

- Enterprise applications. Generally commercial-off-the-shelf (COTS) applications such as SAP, Oracle e-Business Suite and Microsoft SharePoint. These applications are typically designed for traditional physical or virtual environments. Like legacy applications, they're typically designed for large servers (scale-up) and rely on complex hardware clusters for high availability.

- Cloud applications. Designed to leverage the agility and elasticity inherent in cloud platforms. They are available both as commercial Software-as-a-Service (SaaS) and bespoke applications and are commonly developed using modern application frameworks and data services. Unlike legacy and enterprise applications, cloud applications are designed to scale out horizontally and to expect and tolerate component failures.

Table 1. Legacy, enterprise and cloud applications compared

	Legacy applications	Enterprise applications	Cloud applications
Type	Bespoke	Commercial-off-the-shelf (COTS)	Bespoke or Software as a Service (SaaS)
Infrastructure	Mainframe	Intel x86/x64 – virtual and physical	Intel x86/x64 – cloud infrastructure
Scale	Vertical – fewer, larger servers	Vertical – fewer larger servers	Horizontal – many smaller servers
High availability	Specialist fault-tolerant reliable hardware	Hardware failover clustering solutions	Resilient commodity hardware, application layer fault tolerance
Disaster recovery	Active/passive – single site which fails over to recovery site	Active/passive – single site which fails over to recovery site	Active/active – multiple sites in use at all times
Security	Secure physical environments and restricted mobility	Secure physical environments and restricted mobility	Secure data assets embracing mobile end-user devices

So it's easy to see that, although legacy and enterprise applications can run in the cloud, only cloud applications can natively capitalise on the unique benefits of cloud platforms.

This Blueprint describes various techniques organisations can use to enable their legacy and enterprise applications to take advantage of the availability, elasticity and cost savings that are typically associated with cloud computing.

PLATFORMS, LICENSES AND SUPPORT IN THE CLOUD

A major challenge associated with running legacy and enterprise applications in the cloud is determining whether the application provider will allow the solution to be licensed and supported in the cloud. However, the primary challenge relates to the platform the application currently runs on. In many cases, applications will already be running on cloud-compatible platforms such as Microsoft Windows, Java and Linux. In other cases, however, an application will be running on a legacy platform such as mainframe, AS/400 or HP-UX. This section explores the approaches that can help to address these common challenges.
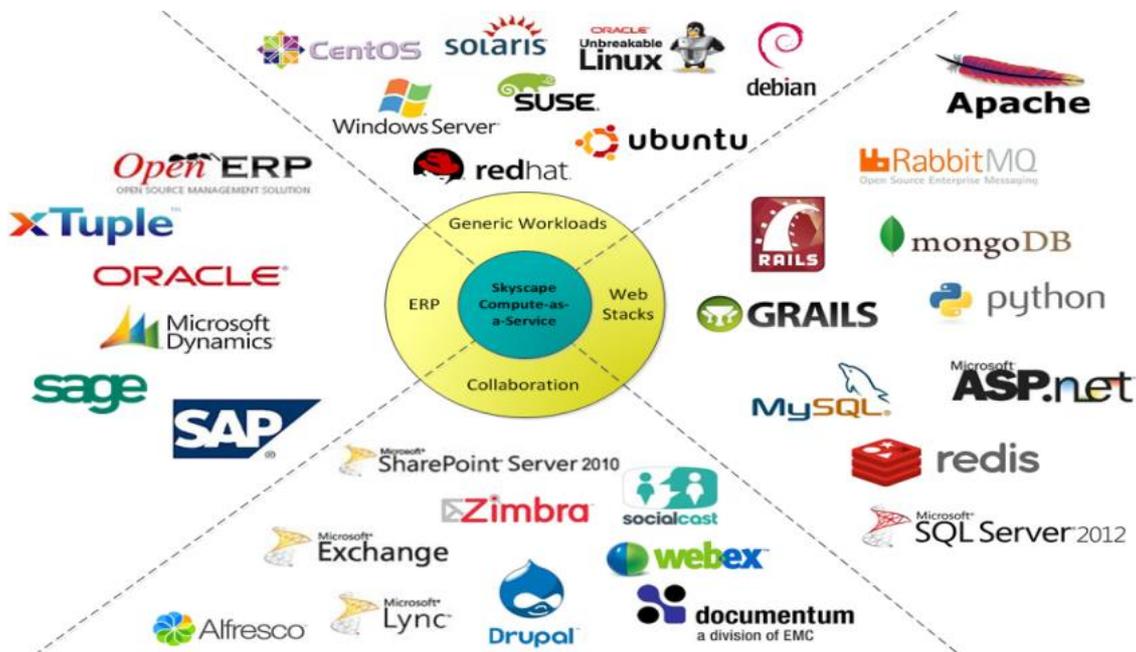
Cloud-compatible platforms

Cloud-compatible platforms natively support commodity, small-systems hardware. Small-systems hardware uses a CPU architecture pioneered by

Intel, which is why they're often referred to as Intel-compatible x86/x64 systems. (X86 refers to 32-bit architectures; x64 refers to 64-bit architectures which are usually backwardly compatible to support 32-bit architectures.) The vast majority of cloud computing platforms available today — including the UKCloud Compute-as-a-Service platform — are designed to natively support Intel-compatible x86/x64 platforms.

The UKCloud Compute as a Service platform is based on the Intel-compatible x86/x64 architecture used by legacy applications, so they can usually run natively on our cloud platform without much effort. Furthermore, unlike some other cloud computing services, UKCloud Compute as a-Service uses VMware virtualisation technology which supports the widest number of operating systems and applications — making it even more likely that your legacy application will run on the UKCloud platform.

Figure 1. Wide support of legacy and enterprise applications
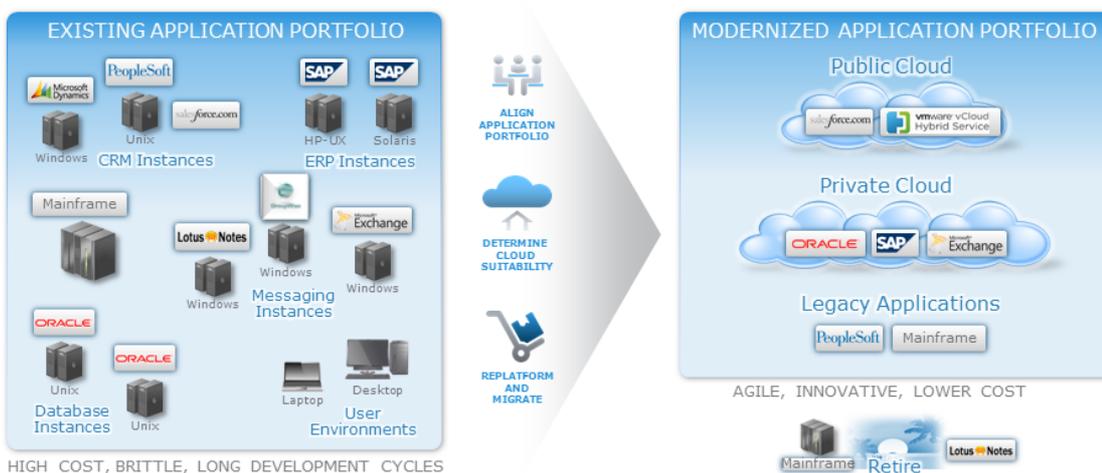
Legacy (non-cloud-compatible) platforms

Before Intel-compatible x86/x64 architectures became popular thanks to their lower costs, other legacy architectures were in widespread use, such as mainframe (eg IBM, ICL), AS/400 and HP-UX. The applications which run on these proprietary architectures are less likely to run natively on a cloud computing platform.

There are two common approaches to switching legacy applications from non-cloud-compatible platforms:

Figure 2. EMC's 'Modernize the Application' portfolio

- **Re-platforming**. Many government organisations are creating new applications to replace the functionality provided by legacy applications. These new applications are typically developed as cloud applications using open source solutions and are designed to take advantage of the benefits of cloud platforms. Legacy and enterprise applications typically have a lot of modules so most organisations re-platform specific components rather than entire applications.

- **Emulation**. Innovative companies such as Micro Focus have developed technology for cloud platforms that emulates legacy environments, making a legacy application 'think' it's running on traditional hardware.

Licensing and application support

Many application providers have embraced virtualisation and cloud computing, and so provide both application support and an appropriate license model to enable applications to run in the cloud. However, some commercial software is still unable to run in the cloud, usually because of one of the following issues:

- Technology issues. As discussed above, most software run on standard Intel-compatible x86/x64 systems, as used in our cloud platform. However, some software requires specific hardware such as mainframe, AIX or Solaris SPARC.

- Support issues. Most vendors are now comfortable about supporting their software in virtualised and cloud environments, including complex enterprise applications such as SAP and Microsoft. On the other hand, some vendors provide limited or no support for the cloud, which could be an important consideration for critical production services.

- Licensing issues. Some software is based on legacy licensing models that aren't compatible with the cloud. For example, Oracle's most typical license scheme requires customers to license all physical processors that the application could potentially run on — a major issue in cloud-scale deployments. Other software, for example Microsoft Windows 7 and 8 desktop OS, can be licensed only to run on physical hardware dedicated to the customer. And some vendors, such as Apple, only license their software to run on their own branded hardware, which prevents it from running legally in the cloud.

Awareness of these restrictions and limitations is driving many organisations to consider open source solutions in preference to commercial solutions (see the reference to re-platforming, above).

Cloud security

Organisations may be discouraged from running legacy or enterprise applications in the cloud because traditional hosting arrangements are perceived to be more secure. This perception stems from the fact that most legacy and enterprise applications are deployed in private environments within an organisation. There is a misconception that, if applications are hosted externally, the data they hold may become less secure.

In fact, the data centres and physical devices used within cloud servers are generally managed more securely than organisations can achieve in house. For example, UKCloud's cloud platform operates from data centre facilities that can achieve accreditation to host IL5 (SECRET) workloads as well as List X status. Indeed, the security of cloud services has been further validated through the CESG G-Cloud Pan Government Accreditation (PGA) Scheme. UKCloud has achieved PGA Accreditation to host both IL2 workloads and IL3 workloads (and IL4 by aggregation).

UKCloud has also achieved PSN Accreditation to provide services at both PSN Assured service (formerly IL2) and PSN Protected service (formerly IL3) — demonstrating the depth of security implemented within the Our cloud platform.

In addition, CESG has published 14 Cloud Security Principles which provide guidance on implementing security within the cloud. UKCloud has implemented all 14 Principles and can advise customers on how to operate securely within our assured cloud platforms.

MIGRATION OPTIONS

The primary challenge of migrating legacy and enterprise applications to the cloud relates to minimising both the cost of the migration and the disruption end users might experience as a result of migration activity. This section explores various approaches to migrating legacy and enterprise applications that can help to overcome these challenges.

Networking and connectivity

Legacy and enterprise applications usually run on an organisation's private networks and so benefit from being well connected. To solve the networking and connectivity challenges associated with migration to the Our cloud platform, organisations will generally take one of three approaches.

Extend the private network into our cloud platform

Unlike many public cloud providers, UKCloud fully supports customers who wish to implement dedicated private circuits. These means that our cloud platform benefits from the same native connectivity as a customer's existing environments.

Both of UKCloud's data centres are in the UK and are on-net for most of the popular telecoms providers including BT, Vodafone (Cable & Wireless), Level 3 and Virgin Media Business. This helps reduce the time and cost associated with implementing a private circuit into the UKCloud platform.

We recommend that customers order a circuit that complies with CAS-T (CESG Assured Scheme for Telecoms), as these circuits can carry most data classified at OFFICIAL (IL2). For more sensitive data and connectivity into the UKCloud Elevated OFFICIAL (PGA IL3) cloud platform, customers will additionally need to implement an overlay solution approved by the Commercial Product Assurance (CPA) scheme. Our cloud platform can host network devices such as routers, hardware encryption modules and WAN acceleration devices.

Use UKCloud's connectivity to government community networks such as PSN

As an alternative to extending a private network, and consistent with the government strategy for Public Services Network (PSN), many customers are taking advantage of UKCloud's secure, resilient connectivity to government community networks:

- **PSN Assured service**. UKCloud has achieved PSN Accreditation for its Compute, Storage and Email cloud services, giving customers complete assurance that UKCloud's cloud platform meets the PSN's security requirements. The UKCloud Assured OFFICIAL (PGA IL2) cloud platform is natively connected to the PSN Assured service, a network appropriate for carrying most data classified at OFFICIAL (previously IL2). The UKCloud Assured OFFICIAL (PGA IL2) cloud platform is therefore immediately accessible to any organisation that also has connectivity to the PSN Assured service.

- **PSN Protected service**. In addition to baseline security provided by the PSN Assured service, UKCloud also provides resilient and scalable connectivity via the encrypted PSN Protected service to the UKCloud Elevated OFFIICAL (PGA IL3) cloud platform. The PSN Protected service is based on the IPED (Inter Provider Encryption Domain). It enables users of the PSN Protected service and of legacy government community networks (including GSI, GSE and PNN) to immediately access and consume services on the UKCloud Elevated OFFICIAL (PGA IL3) cloud platform.

Customers benefit from the fact that these government networks already provide the required assurance related to security and availability. There's also no need to sign up to extended contract periods, which prevents lock-in and enables customers to benefit from far greater commercial flexibility.

Move to a web services model

Many applications use data that doesn't require particularly onerous technical controls. Customers may consider that these applications can be suitably protected using standard commercial-grade web services technologies such as SSL/TLS encryption. So some applications can simply be presented as a secure web service, allowing end users (including citizens) to securely access the application through standard technologies. CESG recognise the viability of this approach within the 14 Cloud Security Principles.

Managed services

System administration tasks related to legacy and enterprise applications are often outsourced to a third party — typically the incumbent managed hosting provider. When considering migrating a legacy or enterprise application to the cloud, it may become apparent that — although the organisation (or the application provider) can support the application layer, and UKCloud provides full support and management of the cloud compute infrastructure — there may be a gap around the management and administration of the application platform (eg provisioning operating systems, patching, backups, break/fix support, etc).

Organisations facing this challenge can either build the system administration skills in house or use a managed services partner. UKCloud has over 100 partners, including many system integrators and managed service providers, who can be introduced to customers who need this support. Many of our partners make their services available via the G-Cloud Framework which facilitates procurement.

Professional services

If an organisation doesn't have a good enough handle on the state of its current IT environment, it can be difficult to plan a cloud adoption strategy. A number of UKCloud partners offer cloud assessment services to help customers in this position evaluate their current environment and assess their cloud adoption options.

Even with a good understanding of its current environment and a clear vision of its target environment, a customer may require project management, engineering and architecture resources to support migration to the target environment.

Physical and hybrid environments

Many legacy and enterprise applications run partially or fully in a physical environment for a variety of reasons including the following:

1. Application providers will typically provide system requirements in terms of common physical server specifications rather than actual sizing requirements.

2. Customers and incumbent managed hosting providers may not have the skills or technology required to run an entirely virtualised environment.

3. Back-end components, such as databases, may require specific hardware to support availability requirements (for example failover clustering).

The first two are easily addressed. As the organisation will have been using the application for some time, it is straightforward to get actual sizing requirements based on resource utilisation statistics, which makes it relatively simple to determine the amount of resource required within a cloud platform. For point 2, the benefit of Infrastructure as a Service is that the cloud service provider delivers all the required skills and experience to run an entirely virtual environment.

Point 3 can be more challenging. Legacy high availability solutions, such as failover clustering, were designed for traditional physical environments and are difficult to re-engineer to properly take advantage of a cloud platform. Organisations therefore often look for a hybrid solution that lets them run the front-end components in the cloud and the back-end components as physical servers.

The disadvantage of this approach is that it creates a form of lock-in which makes it impossible to enjoy the full commercial flexibility offered by cloud platforms. That said, UKCloud works with a number of partners who can deliver against these hybrid cloud requirements. Some of these partners are evaluating Database-as-a-Service models, which could enable applications to consume scalable, resilient traditional database architectures.

Figure 3. UKCloud's vCloud-powered platform facilitates hybrid cloud

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OPTIMISING LEGACY AND ENTERPRISE APPLICATIONS

As described above, the common challenges associated with migrating legacy and enterprise applications to the cloud can be overcome in a variety of ways. But the problem remains that these applications are not designed to capitalise on the cloud benefits of elasticity and consumption-based costs. This section describes how customers can optimise our cloud platform to optimise support for legacy and enterprise applications.

Vertical scale

Cloud applications are designed to scale horizontally (scale out) under load, so that it is easy to scale back by shutting down unneeded instances when the load subsides. Legacy and enterprise applications, on the other hand, are usually designed to scale vertically (scale up), adding more CPU, memory and storage resources to fewer instances in order to meet

demand. Because our cloud platform can provide larger virtual machines than most cloud platforms, it can support the vertical scale requirements of many legacy and enterprise applications.

Further, some legacy and enterprise applications support the hot-add and hot-remove capabilities of the VMware-powered UKCloud cloud platform.

Figure 4. Vertical scale
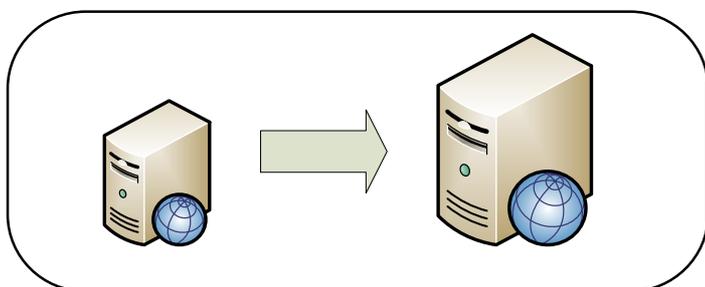
This enables customers to add and remove CPU, memory and storage resources without rebooting the virtual servers, which eliminates downtime. If applications don't support hot-add and hot-remove, customers can programmatically reconfigure their virtual machines to minimise the amount of downtime required while the application servers restart.

High availability

Whereas traditional physical servers require complex clustering solutions to mitigate the impact of infrastructure layer failures, our cloud platform provides applications with seamless and automatic high availability through the combination of:

- UKCloud's persistent storage model — the storage supporting a virtual server can survive a reboot

- VMware High Availability (VMware HA) technology, which continuously monitors the cloud infrastructure and automatically restarts virtual servers on healthy hosts if a part of the cloud infrastructure fails

With no worries about the risk of hardware failure on our cloud, customers can focus instead on mitigating risks to application layer availability.

Disaster recovery

Traditional disaster recovery (DR) solutions typically implement an active/passive model: the legacy or enterprise application runs actively in one data centre and operates in standby in another data centre. The standby service could range from a real-time replica of the production service (for example using synchronous replication) to a cold standby service that restores the application from a backup. In the event of a disaster affecting the primary data centre, the time taken to restore the application service (RTO) could range from seconds to days, and the amount of data potentially lost (RPO) could also range from none to several days' worth.

UKCloud has designed its cloud platform to enable equivalent DR solutions. All UKCloud sites (also referred to as zones) are active and capable of running active workloads. Applications can use this capability to deliver services with zero downtime and zero data loss. To achieve this, applications must be designed to expect an entire site to become unavailable and to gracefully resume operations within the remaining site until the other site becomes available again. This can be achieved in one of two ways:

- **Application layer replication**. Using features common to legacy and enterprise applications such as database replication (for example Oracle Data Guard, SQL Log Shipping or Exchange Data Availability Groups).

- **Infrastructure layer replication**. At the ENHANCED service level, our cloud platform synchronously replicates data (providing zero data loss) and automatically enables failover of workloads from one site to the other (typically within a few hours of a major, sustained failure).

Consumption-based costs

Unlike cloud applications which can automatically and dynamically scale horizontally so that the solution only ever uses the resources it actually requires, legacy and enterprise applications tend to be more static. For these applications to benefit from the consumption-based cost model of our cloud platform, the focus has to shift from elasticity to running the application only when it is needed.

For example, many applications are used during business hours only (eg 0800–1800, Monday–Friday) or at defined times during the month or the year. In a traditional physical environment, there might be little value in shutting down the physical server when it is not required, but in the cloud the costs of running the server reduce significantly when the server isn't in use. As our cloud platform provides persistent storage for all virtual servers, customers can be assured that the server and all its data will be available whenever they're needed. (Some cloud platforms, such as Amazon Web Services, provide non-persistent storage which makes it more difficult to achieve a solution for legacy and enterprise applications.)

UKCloud has calculated that running an environment between 0800 and 2000, Monday to Friday, would equate to less than one-third of the cost of running the same environment 24 hours a day, seven days a week.

To facilitate the scheduled shutdown and restart of legacy and enterprise applications, customers can use the UKCloud API to do these tasks programmatically rather than manually. UKCloud has produced sample scripts which customers can adapt to meet their needs. Refer to the Blueprint 'Programmatic control of the UKCloud platform'.

Non-production environments

Many customers start by migrating non-production environments to our cloud platform, as this provides a relatively low-risk way to test a solution in the cloud.

Our cloud platform provides a number of features that can help customers improve the quality and integrity of non-production environments by making them more representative of the production environment.

This is primarily achieved by using features such as vApps (logical grouping of one or more virtual machines) and cloning (the ability to make an exact replica of a vApp). In particular, customers can use create a 'fenced clone' of a production vApp to create an identical, representative version for non-production purposes such as UAT, training or support.

A fenced vApp maintains the exact internal configuration of the production vApp (eg host names, IP addresses and SIDs) but provides a unique external network to avoid interfering with the production vApp.

Figure 5. Cloned and fenced vApps are exact replicas of production vApps

Production vApp   **Cloned & Fenced vApp**
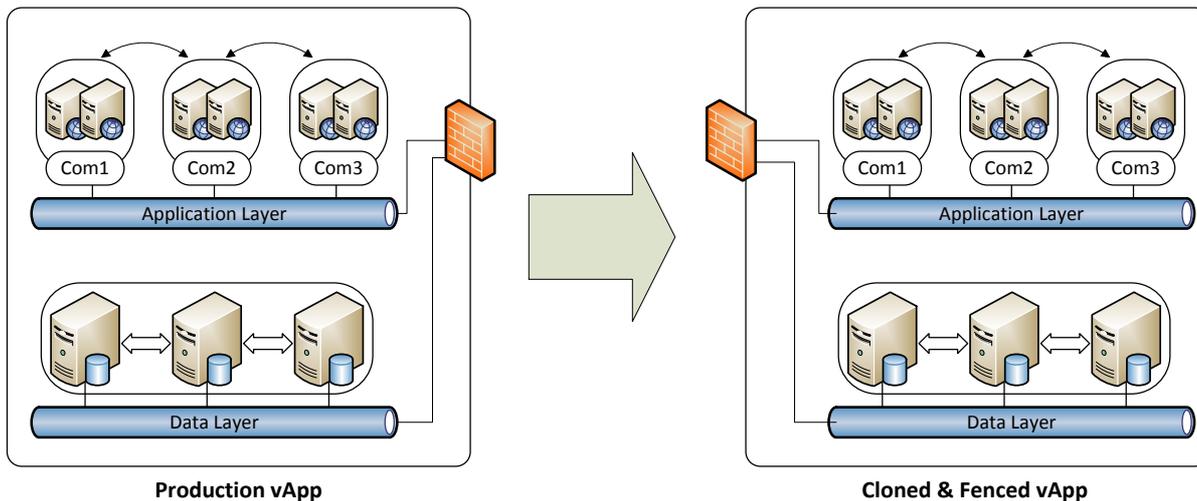
Scalable object storage

Traditional storage models such as SAN (block storage) and NAS (file storage) aren't well suited to the scalability, security and availability design of cloud platforms. In their place, a new storage model — object storage — has emerged, which is inherently optimised for cloud. It provides a much higher level of autonomy relative to traditional storage models, as capacity, security and availability are defined and provided on a per-object rather than a per-volume basis.

Most importantly, object storage is loosely coupled, as it is controlled and accessed over a REST API. This makes it an ideal target for data such as web assets (such as PDFs and videos,) and large datasets (for example archives and backups).

UKCloud API Accessible Storage is an object storage solution that's optimised to work with cloud applications. It is secure (suitable for OFFICIAL data at IL2 and IL3), scalable and available in both our UK data centres. The storage can be presented to legacy and enterprise applications as traditional network file shares or mount points to make it easy for these applications to benefit from a cloud storage solution.

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EXAMPLE APPLICATION ARCHITECTURE

This example architecture for a legacy or enterprise application would serve an internal case management application used by civil servants who work business hours only. It would typically be designed as a two-tier application with:

- An application layer responsible for processing the user requests and delivering application functionality

- A data layer responsible for storing persistent data assets

The following section describes each layer in more detail.

Application layer

This layer provides the application functionality. It's likely there will be several types of application server at this layer. For example, some servers might provide the searching and indexing function, some might provide the reporting and analytics function, and others might provide the content management function.

For enterprise application components like SharePoint, Oracle E-Business and SAP it is prudent to follow the requirements of the application. Some components may need to scale up (in which case larger servers can be used); others might maintain a state (in which case the servers should run at the with the backup option to provide automated VM backup and data replication as required).

If possible, application components should be distributed across many smaller servers rather than fewer larger servers. This makes it more feasible to

switch off individual application components when they're not required. For example, a single server running a batch process as well as an interactive process probably can't be powered down. But if two smaller servers run one of those processes each, the server running the batch process can be shut down when not required.

Data layer

The data layer is where the data which drives the application is persistently stored. Traditionally, this is the most secure layer of the application, designed to maintain the confidentiality, integrity and availability of sensitive data.

The most common traditional data store is a relational database management system (DBMS) such as Microsoft SQL Server, Oracle or DB2. All of them require very powerful, reliable server hardware and often need expensive licenses to achieve high availability through clustering technology.

As described earlier in this Blueprint, customers can consider relying on the high availability features of our cloud platform, to avoid having to purchase licenses or implement hardware clustering.

Unless the application supports hot-add, it is likely that the VMs will need a large resource configuration supported by the large VM sizes available on our cloud platform. They'll be storing important data, so the automated backup option will be appropriate and will provide protection through the automated VM backup. Alternatively, customers can opt for VMs without the automated backup and use UKCloud Storage-as-a-Service to store backups and archives of important data.

SUMMARY

This Blueprint has explored how legacy and enterprise applications can be optimised to take advantage of the benefits of cloud. UKCloud provides native support for these applications as our services offer:

- Choice of VM sizes. We recognise that many legacy and enterprise applications are designed for vertical scale (scale up) and require large VMs.

- Multiple sites. Our sites are over 100km apart, connected by secure, low-latency fibre circuits, and able to provide a range of familiar DR options to legacy and enterprise applications.

- Choice of security levels. Most cloud platforms are available only at lower security levels, as they are natively connected to the internet. UKCloud additionally provides a cloud with higher security, which is natively connected to government community networks including PSN.

- Well documented API. This enables customers to programmatically control and scale their cloud environment (for example, scheduled stop and restart of servers that are required during business hours only).

In addition to our own expertise as a leading G-Cloud provider, we have over 100 partners who can deliver many enterprise applications as a service (including Oracle as a Service and Dynamics as a Service); and can help you migrate legacy and enterprise applications to the cloud and operate them in the new environment.

ABOUT UKCLOUD

UKCloud has developed a range of cloud services designed specifically for the UK public sector, to help increase efficiencies, reduce costs, significantly improve procurement times and increase transparency. Our services are *easy to adopt, easy to use and easy to leave* to ensure that our customers remain in complete control with minimum risk. We were one of the first G-Cloud providers to achieve Pan Government Accreditation (PGA) up to Elevated OFFICIAL, and our services continue to achieve formal UK Government accreditations which make them suitable for all data at OFFICIAL (including OFFICIAL-SENSITIVE).

UKCloud's full offering consists of:

1. Infrastructure as a Service (IaaS) – seven offerings around Compute and Storage on demand

2. Software as a Service (SaaS) – offerings for email and collaboration as well as secure sync-and-share of files to help teams work effectively in groups, using a variety of devices

3. Platform as a Service (PaaS) – based upon Open Source Digital Application Platform and Hadoop which provides organisations the benefits of using a commodity cloud platform without the added management overheads

All of UKCloud's UK sovereign cloud computing services are hosted in one (or both) of our highly resilient tier 3 UK data centres in Farnborough and Corsham. UKCloud services are delivered with leading technologies from UKCloud Alliance Partners: QinetiQ, VMware, Cisco, EMC and Ark Data Centres. The Cloud Alliance also provides a collaborative resource which drives innovation and technical product development, helping to continually improve UKCloud's offering to meet the needs of the UK public sector.

UKCloud is focused on providing cloud services in a more agile, secure and cost effective manner. We strive to deliver solutions that harness technology as a way to facilitate the changes that are needed to streamline processes and reduce costs to support the UK public sector and, ultimately, UK citizens and taxpayers.

MORE INFORMATION ▶

For further information about UKCloud and how we can help you, please send an email to info@ukcloud.com