**Syllabus**

**UNIT 5**

Moving Applications to the Cloud

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**Extra Reading**: Six R for Cloud Migration

* 1. **1. Cloud Migration Strategies and Process:**

What is a Cloud migration strategy?

A **cloud migration strategy** is the high-level plan an organization adopts to move existing on-premises and/or co-located application workloads and their associated data into the cloud. Most plans include a public cloud migration strategy where the target is Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure, or other public cloud providers. Although most workloads will benefit from cloud migrations, not all workloads are suitable for migration.

A successful enterprise cloud migration strategy will include **prioritizing workloads for migration**, determining the correct migration plan for each individual workload, developing a pilot, testing, and adjusting the strategy based on the results of the pilot. A cloud migration strategy document should be created to guide teams through the process and facilitate roll-back if necessary.

Whether or not the source and destination platforms have similar architecture and use of migration tools that are fit-for-purpose will have a significant impact on the effort and cost of migration.

The desired final state is a seamless transition of the applications from on-premises to the desired cloud infrastructure without impacting application availability or day to day operations.

Why use a cloud migration strategy?

Adopting a cloud migration strategy helps identify and execute the fastest, lowest cost, least disruption transition from on-premises to cloud. And, can help determine which existing application workloads can be discontinued or replaced, which should be rewritten, which may remain on-premises, which should be moved as-is to a cloud platform to run as-is or targeted to be augmented with native cloud services, and which cloud is the right destination for which application. An enterprise cloud migration strategy will include a combination of these approaches to address the entire application portfolio.

Since every organization is different, an enterprise cloud migration strategy should be tailored exactly to their particular needs and to achieve the desired business and technical outcomes. This requires knowledge of the business goals and the application portfolio that can provide visibility into the TCO (Total Cost Ownership) and ROI of undertaking a migration.

What are the benefits of a cloud migration strategy?

1. Cost and time savings are a major benefit of a well-planned cloud migration.  Migration can take months or years if source and destination platforms are different. With consistent infrastructure and consistent operations, migrations can be automated, and workloads moved en masse without any downtime.
2. Many organizations undertake a cloud migration to support overall IT modernization efforts. Organizations that adopt a cloud-native approach utilizing micro-services and APIs naturally use cloud providers – frequently more than one – to deploy modern, containerized application workloads. Additionally, since cloud providers utilize the most modern servers and storage, organizations no longer need to plan for technology refresh, and can instead focus efforts on solving business problems without worrying about upgrading memory or OS in a server.
3. Instant scalability can be realized by migrating to public cloud providers, enabling enterprises to meet changing demand at will, whether fluctuations are caused by seasonality, business growth, or another spike. Cost savings can be considerable since resources are only paid for while in use.
4. Security can be improved by cloud migration strategy as well. Although most cloud providers utilize a shared responsibility model, cloud infrastructure is typically far greater than an organization’s own on-premises infrastructure was. Most cloud providers offer security analytics, block unwanted traffic, and ensure OS and security updates are applied with no action required by user organizations. Additionally, cloud-based applications and data are always available regardless of the status of end-user equipment.
5. Accessibility is greatly enhanced by cloud migrations. Since applications and data can be accessed from virtually anywhere, employee productivity likewise improved since workers can access business-critical applications and data from home, while on the road, even while at the office exactly as they had in the past. Additionally, since business applications and data are now in the cloud, machine downtime does not cause loss of access and operations can continue virtually uninterrupted.

Additionally, access between applications can be greatly enhanced by a cloud migration. Cloud-native application methodologies promote the use of APIs to share information between applications and services regardless of where they reside. This approach not only provides a standard way for applications to communicate, it also improves access to information previously siloed into a single application. Now data can be shared among applications in a simple, predictable manner.

**How does a cloud migration strategy work?**

When deciding on migration strategies, organizations should start by considering the architecture and needs of each application, and consider the available skills, budget and time frame to achieve the desired goals. First, teams must start with an assessment of what is currently in place to understand the maturity of each workload. **This may require a deep discovery stage for every instance of every existing application.**

Then the migration process should be designed with **milestones, clear goals, reasonable durations** for each task and an understanding of possible risks should things go awry during a workload migration.

Every migration should include a **pilot project**, perhaps starting with a rehosting or relocating task. This can help identify any gaps that are uncovered and adjust for them moving forward.

To execute a migration at scale, the organization should focus on three key points of optimization:

* Tailor applications and instances for peak performance
* Maintain a focus on operations and governance
* Develop required expertise to create the managed services team that will oversee migration and operations

What are the types of cloud migration strategy?

There are several options when considering workload migration.

* **Relocating** Perhaps the simplest form of migration, this strategy refers to moving VMware VMs from on-premises hardware to VMC. This can be achieved by reprovisioning from scratch, a cold migration, or a live migration.
* **Reprovision from Scratch** While this might not technically be considered a migration, it may be an option some of your cattle workloads. Instead of moving them, it might be possible to spin them up as new workloads in VMware Cloud on AWS instead. Simply bring them up as **new in the cloud and turn the old ones off** in your on-premises environment.
* **Cold Migration** The next migration strategy is a cold migration where a **workload is stopped,** **moved over to your VMware Cloud on AWS and then restarted there**. This option may work well for your non-production workloads where you can simply turn it off with minimal business impact (e.g. development or test workloads).
* **Live Migration** The ability to move a live running VM between your on-premises environment and your VMware Cloud on AWS SDDC is almost table stakes when talking about a hybrid cloud. vMotion can be leveraged with VMware Cloud on AWS.
* **Replatforming** This model modifies or replaces certain components to better take advantage of the cloud provider’s features, for example switching to managed services or replacing commercial off the shelf software with an open-source equivalent.
* **Repurchasing** Decommissions the existing application and replaces it with an already available cloud-based version from the cloud provider’s marketplace – in essence replacing one license fee with another. This approach is often utilized for older on-premises ERP, finance, CRM or HR applications which have equivalent functionality either in an app marketplace or as a SaaS application. This is also a good choice for legacy applications not easily virtualized or migrated in other ways.
* **Refactoring** This approach entails an entire re-architecting of an application to take advantage of unique cloud provider features. When cloud-native features are required or the agility and scalability of microservices based applications calls for it, these applications are typically then broken up into smaller pieces or services and often deployed in a containerized environment on one or more public clouds. Although this is the most expensive approach to migration, the resulting benefits can far exceed the potential risks. Over time, many applications that were migrated with another strategy may become refactored as the increased benefits of cloud-native applications beckon.
* **Retaining** Not truly migration, this is retaining an application on its existing on-premises infrastructure. If there is still a strong investment, or if a critical application is running on legacy mainframe or minicomputer platforms, the organization may wish to keep those well-behaved and productive applications right where they are, using APIs to integrate with cloud-based resources. This results in a hybrid cloud migration strategy with workloads in public and private clouds.
* **Retiring** Every applications becomes obsolete, wither due to redundancy or the availability of better options in a cloud-based offering.

What are the challenges of a cloud migration strategy?

The road to the public cloud is littered with failed and delayed migrations. Organizations must have a clear intention on what actually needs to be migrated and why, rather than jumping in with both feet and trying to shift each and every workload to the public cloud just because they want to. Cloud migration projects often require work for infrastructure, operations, and development teams.

Rather, it is critically important to first determine the overall desired end state and realistically evaluate the time it will take to get there: whether it will be a hybrid cloud migration strategy, multi-cloud migration strategy that includes multiple public cloud providers, both of those options, or neither.

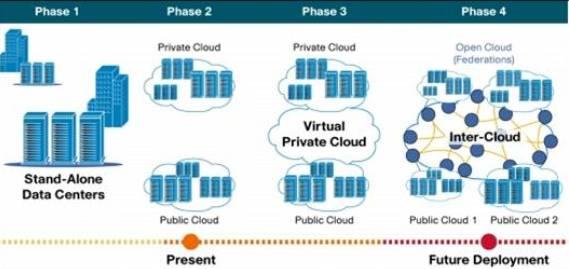
Care also must be taken with determining the best way to deal with legacy servers and applications. Some applications are more than suitable for cloud migration, but many are not, and the final disposition of retired hardware – and data center real estate – must be considered and factored into overall plans.

Every organization should put an emphasis on these three factors while creating their cloud migration strategy.

* Security. The cloud offers a shared responsibility model and workloads should be secured using a zero-trust approach by utilizing stateless transactions where possible.
* Governance and Compliance. Regulations vary widely by geography and industry. Cloud providers can offer physically secure storage of an organization’s data, but the cloud customer must ensure that regulatory mandates are complied with for things such as retention and privacy of data.
* Cost Management. Each organization is responsible for ensuring that unused accounts, workloads, and data are deprovisioned, and that applications do not replicate needlessly creating VM sprawl or container sprawl across the cloud.
  1. **2.Issues in Inter Cloud:**

[**Intercloud**](http://www.techopedia.com/definition/7756/intercloud)**or  ‘cloud of clouds’** is a term refer to a theoretical model for **cloud computing services based on the idea of combining many different individual clouds into one seamless mass** in terms of on-demand operations. The [intercloud](http://en.wikipedia.org/wiki/Intercloud) would simply make sure that **a cloud could use resources beyond its reach**, by taking advantage of pre-existing contracts with other cloud providers.

The Intercloud scenario is based on the key concept that **each single cloud does not have infinite physical resources or ubiquitous geographic footprint.** If a cloud saturates the computational and storage resources of its infrastructure, or is requested to use resources in a geography where it has no footprint, it would still be able to satisfy such requests for service allocations sent from its clients.



The Intercloud scenario would address such situations where each cloud would use the computational, storage, or any kind of resource (through semantic resource descriptions, and open federation) of the infrastructures of other clouds. This is analogous to the way the Internet works, in that a service provider, to which an endpoint is attached, will access or deliver traffic from/to source/destination addresses outside of its service area by using Internet routing protocols with other service providers with whom it has a pre-arranged exchange or **peering relationship.** It is also analogous to the way mobile operators implement roaming and inter-carrier interoperability. Such forms of cloud exchange, peering, or roaming may introduce **new business opportunities among cloud providers if they manage to go beyond the theoretical framework.**

**What is intercloud, exactly?**

**Intercloud is a cloud deployment model that links multiple public cloud services together as one holistic and actively orchestrated architecture. Its activities are coordinated across these clouds to automatically and intelligently move workloads (e.g., for data analytics), based on criteria like their cost and performance characteristics.**

**Intercloud vs. multi-cloud vs. hybrid cloud**

**An intercloud architecture requires a multi-cloud deployment. Multi-cloud means running applications in multiple clouds, i.e. using infrastructure from a cloud provider like AWS, Microsoft Azure, or Google Cloud.**

**Both intercloud and multi-cloud are different from hybrid cloud, which is the combination of a public cloud with on-premises infrastructure. Hybrid multi-cloud is a combination of multiple clouds, along with an on-premises environment.**

**To use an analogy, think of the three architectures like this:**

* [**Hybrid cloud**](https://www.teradata.com/Trends/Cloud/Hybrid-Cloud-Architecture)**: An apple (public cloud) and an orange (on-premises).**
* [**Multi-cloud**](https://www.teradata.com/Trends/Cloud/Multi-Cloud-Guide)**: Multiple distinct apple varieties.**
* **Intercloud: A new apple varietal, seamlessly combining the traits of the above.**

**Although intercloud is an advanced form of multi-cloud computing, the way in which it works is actually most similar to a hybrid cloud.**

**An intercloud architecture moves data between the infrastructure of multiple cloud service providers (CSPs). This movement is analogous to how an architecture-spanning hybrid cloud allows on-premises data to move back and forth to the cloud, depending on the use case and its associated cost and latency requirements.**

**Three reasons to explore intercloud**

**Intercloud is still in its infancy. Many enterprises are still in the process of migrating their data sources to a multi-cloud architecture, or connecting their on-premises environments to a hybrid cloud. But intercloud could soon become a viable alternative to traditional multi-cloud and hybrid cloud, due to:**

**1. Active cloud management**

**This is the major value proposition of intercloud. Decisions about where to place a particular dataset or application no longer require human deliberation, as would happen with multi-cloud. The intercloud architecture “knows” where to send the information at any given moment.**

**Intercloud also takes advantage of tight integrations between public clouds and orchestrates activity on its own, on the fly. Think of it as the cloud architectural equivalent of a TV equipped with variable refresh rate (VRR). For example:**

**VRR-enabled TVs can dynamically change their refresh rates (e.g., from 60 Hz to 120 Hz and to anything in between) to provide the best motion smoothness for the content on screen, based on current frame rate. All of this happens automatically and doesn’t require digging through menus to change settings. Intercloud does something similarly streamlined for cloud analytics workloads.**

**2. Cost savings**

**The intelligent automation of intercloud makes it easier to get the**[**best price**](https://www.teradata.com/Cloud/Pricing)**for cloud resources moment by moment. For instance, an intercloud deployment may look up the spot price of compute in Cloud B, find that it is lower than the current equivalent cost in Cloud A, and move a workload from Cloud A to Cloud B automatically.**

**Such functionality makes intercloud a powerful arrow in the cloud cost optimization quiver. The combination of a connected multi-cloud data platform and intercloud architecture lets enterprises find the right mix of consumption and reserved pricing for a wide range of possible analytics workloads and business requirements.**

**3. Performance optimization**

**By finding the optimal cloud service provider for every workload, intercloud ensures optimal performance and pricing for analytics. Data from numerous sources can be reliably loaded, queried, and scaled across clouds.**

**Looking ahead, intercloud will extend this level of performance and scalability for analytics across each company’s clouds of choice. A key enabler of intercloud will be a flexible data platform that works the same in every cloud and offers first-party integrations with the major cloud services.**

* 1. **3.Applications in the Clouds:**
  2. Applications of Cloud Computing

Cloud technology offers several applications in various fields like business, data storage, entertainment, management, social networking, education, art, GPS, to name a few.

The major types of cloud computing service models available are [Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Software as a Service (SaaS)](https://www.simplilearn.com/saas-paas-iaas-quick-comparison-article). Plus, there are platforms like Public Cloud, Private Cloud, Hybrid Cloud, and Community Cloud.

Let’s start elaborating on the top 7 applications of cloud computing.

1. Online Data Storage

Cloud Computing allows storage and access to data like files, images, audio, and videos on the cloud storage. In this age of big data, storing huge volumes of business data locally requires more and more space and escalating costs. This is where cloud storage comes into play, where businesses can store and access data using multiple devices.

The interface provided is easy to use, convenient, and has the benefits of high speed, scalability, and integrated security.

2. Backup and Recovery

Cloud service providers offer safe storage and backup facility for data and resources on the cloud. In a traditional computing system, data backup is a complex problem, and often, in case of a disaster, data can be permanently lost. But with cloud computing, data can be easily recovered with minimal damage in case of a disaster.

3. Big Data Analysis

One of the most important applications of cloud computing is its role in extensive data analysis. The extremely large volume of [big data](https://www.simplilearn.com/what-is-big-data-analytics-article) makes it impossible to store using traditional data management systems. Due to the unlimited storage capacity of the cloud, businesses can now store and analyze big data to gain valuable business insights.

4. Testing and Development

Cloud computing applications provide the easiest approach for testing and development of products. In traditional methods, such an environment would be time-consuming, expensive due to the setting up of IT resources and infrastructure, and needed manpower. However, with cloud computing, businesses get scalable and flexible cloud services, which they can use for product development, testing, and deployment.

5. Antivirus Applications

With Cloud Computing comes cloud antivirus software which is stored in the cloud from where they monitor viruses and malware in the organization’s system and fixes them. Earlier, organizations had to install antivirus software within their system and detect security threats.

6. E-commerce Application

Ecommerce applications in the cloud enable users and e-businesses to respond quickly to emerging opportunities. It offers a new approach to business leaders to make things done with minimum amount and minimal time. They use cloud environments to manage customer data, product data, and other operational systems.

7. Cloud Computing in Education

E-learning, online distance learning programs, and student information portals are some of the key changes brought about by applications of cloud computing in the education sector. In this new learning environment, there’s an attractive environment for learning, teaching, experimenting provided to students, teachers, and researchers so they can connect to the cloud of their establishment and access data and information.

# 7 Critical Cloud Service Attributes

Cloud service providers vary a lot when it comes to reliability, security, and other qualities. Here's what to look for to make sure a cloud provider meets your needs.

Moving one or more of your IT services to the cloud has many benefits, including lower capital costs, potentially lower operating costs, better support for mobile and remote workers, and infrastructure flexibility. When properly implemented, cloud services can change the corporate view of IT as a cost center to a competitive advantage able to positively affect top-line revenue.

However, not all cloud service providers are created equal. In fact, service providers can vary significantly in many attributes such as reliability, security, and support, to name a few. Indeed, if you move your IT service to a provider that does not meet the minimum standard your company requires for a particular service quality, you undoubtedly will hear about it from your end-users and C-level executives.

Making sure a cloud service provider delivers the kind of service characteristics your company requires to run the business is critical to successfully migrating IT services to the cloud. To ensure you make the right choice, look for the following attributes when evaluating a cloud services provider:

**1. Reliability**  
Business-critical services are just that: critical! Businesses cannot afford to have their IT services go down because an outage can impact the business significantly. Delayed quotes, missed calls or emails, and unshared documents can all affect top-line revenue as well as bottom-line costs. **Reliability is about minimizing the probability of a service outage. Look for service providers that have a history of minimal cloud outages.**

**2. Availability**  
Availability is related to reliability. While reliability is an indication of how often a service goes out (or conversely stays up), availability is about the recovery time when a service actually goes down. Ideally, you want a service provider that has the fewest and shortest outages.

Together, this is generally expressed in a reliability/availability percentage, such as 99.9%. Look for vendors with the highest reliability/availability percentage, keeping in mind that even a 99.9% rating means that the service can go down for as much as 43 minutes every month.

**3. Scalability**  
A huge benefit of cloud services is their ability to scale to whatever size you need and to be available wherever you need the service. Service providers need to be deployed in enough data centers around the world to support the connection of users from anywhere your company does business. Look for service providers that can meet the needs of your company's locations.

**4. Security**  
One potential disadvantage of moving your IT services to an external cloud is poor security. If the cloud service provider does not have the appropriate and necessary security safeguards in place, security can be compromised. Look for cloud providers that have multi-factor authentication built into their service as well as full encryption in-transit and at-rest for content. Centralized security policies to manage remote/local devices are also important.

**5. Quality of Service (QoS)**  
Just delivering a service is not good enough for most businesses, especially when the service has a real-time aspect to it, such as voice/video calls or web meetings. The key to QoS is to find service providers that control and manage as much of the solution as possible, including the service technology, bandwidth connectivity, and networking equipment. The more a service provider can manage and control, the better the QoS will be.

**6. Service-Level Agreements (SLA)**  
With most legal agreements, the goal for both parties is to never have to resort to legal enforcement of the agreement. However, in many cases, a strong SLA can offset the impact on a business when a service does not perform to the guaranteed level. As recently as just this month, Microsoft had an extended outage on its Azure platform that triggered credit compensation in its SLA. Compare service provider SLAs to ensure that you get the best protection.

**7. Support**  
Support is a key area that is often overlooked when evaluating service providers, but it remains a critical aspect of any service. The ability to contact support in real time through a call or IM at any time of the day is essential for companies that conduct business around the world or that have time-critical interactions with customers or prospects.

In addition, as companies become more mobile and employees more distributed to remote locations, the ability for the service provider to provide real-time 24/7 support becomes even more critical. Look for service providers that can provide 24/7 real-time support.

The transition to a cloud service is not easy, and moving multiple services at the same time can be catastrophic if not planned properly. Understanding these seven service-provider attributes and determining the minimum levels your company needs to run your business is key. By holding cloud service providers accountable and not compromising on these seven attributes, companies can take their IT to the next level while saving on opex and capex costs.

**Cloud bursting**

How cloud bursting bridges private and public clouds to increase computing resources

Cloud bursting is a cloud computing configuration that enables a private cloud to access public cloud resources by “bursting” into a public cloud when computing demand spikes.

Why settle for just a private cloud infrastructure when you can join forces with a public cloud? It’s this sort of reasoning that has made hybrid cloud the most popular form of cloud computing and made cloud bursting a popular way to access the power of hybrid cloud computing, on demand.

What is cloud bursting?

Cloud bursting is an application configuration that allows the private cloud to “burst” into the public cloud and access additional computing resources without service interruption. These cloud bursts can be triggered automatically in reaction to high demand usage or by a manual request.

The technology behind cloud bursting includes [infrastructure as a service (IaaS)](https://www.atlassian.com/microservices/cloud-computing/infrastructure-as-a-service), a cloud computing infrastructure that enables developers to dynamically configure cloud resources on demand. [DevOps tools](https://www.atlassian.com/devops/devops-tools) like configuration management and [infrastructure as code (IaC)](https://www.atlassian.com/microservices/cloud-computing/infrastructure-as-code) are used to specify the capacity thresholds or trigger events that will activate cloud bursting.

The benefits of cloud bursting

Flexible scaling

Cloud bursting provides the agility to rapidly adjust and adapt to changing cloud capacity needs. If teams are hit with an unexpected surge in traffic to a private cloud they can seamlessly expand to the public cloud. Accessing a public cloud offers organizations access to almost limitless resources, including large public cloud providers like [Amazon Web Services (AWS)](https://www.atlassian.com/partnerships/aws) and [Microsoft Azure](https://www.atlassian.com/partnerships/microsoft/integrations). Plus, cloud bursting can free up local cloud resources that can be used for other purposes.

Business continuity

Cloud bursting can help ensure important applications and services do not have a disruption in service. Since cloud bursting occurs behind the scenes, users most likely will not see any disruption, if there is minimal latency.

Lower operating costs

Since organizations only pay for additional resources when needed, they can reduce their private cloud infrastructure costs by maintaining a minimal set of resources needed for critical and confidential applications.

When do organizations need cloud bursting?

Cloud bursts are triggered by spikes in computational resource demand. These bursts could be an influx of user traffic or expensive one-off computational tasks. Some common cloud bursting situations include:

Software development

Software development and analytics are two of the most common use cases for cloud bursting. DevOps teams often use multiple virtual machines for testing purposes, which are only needed for a short amount of time.

Marketing campaigns

Marketing campaigns for new product launches can generate a huge influx of traffic that requires extended cloud resources. Imagine the marketing push for an anticipated Hollywood movie or video game release. These events generate a temporary stampede of traffic that subsides after the launch news passes, so it is a great time to utilize cloud bursting.

Big data modeling and queries

Big data companies frequently need to execute one-time queries or generate models that will exceed the capacity of their private cloud. These tasks are well suited to cloud bursting. The company can burst into the public cloud for additional resources to expedite the task. Some granular examples of big data tasks include:

* High-fidelity 3D rendering
* AI and ML model training
* Autonomous vehicle simulation

Seasonal businesses

Seasonal businesses need additional computational resources during known peak times. For example:

* Holiday rush shopping for an eCommerce or shipping site
* End-of-business-quarter financial processing
* Political election seasons (campaign fundraising and website traffic for education on a candidate's proposals)

In conclusion...

When businesses need agility to react quickly to changing business demands that strain cloud computing resources, they can burst into the hybrid cloud. They expand cloud capacity for a short (or long) time, without needing to expand private cloud resources indefinitely.

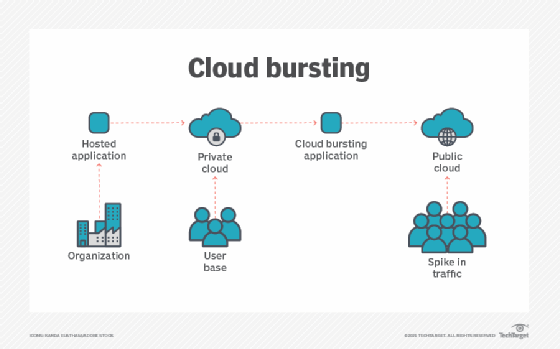
**What is cloud bursting?**

Cloud bursting is an application deployment technique in which an application runs in a private cloud or data center and bursts into a public cloud when the demand for computing capacity spikes. This deployment model gives an organization access to more computing resources when needed.

When compute demand exceeds the capacity of a private cloud, cloud bursting gives an organization additional flexibility to deal with peaks in IT demand. In addition, cloud bursting frees up local resources for other critical applications.

The advantage of a [hybrid cloud](https://www.techtarget.com/searchcloudcomputing/definition/hybrid-cloud) deployment model like cloud bursting is that an organization only pays for extra compute resources when they are needed.

The private cloud is the primary means of deployment in a cloud bursting model, with public cloud resources being used in times of increased traffic. When a private cloud reaches its resource capacity, overflow traffic is directed toward a public cloud without service interruption. Once reduced to normal traffic levels, data is moved back to the private cloud. Cloud bursts can be triggered either automatically based on high usage demands or manually via a request.



This image describes what the general cloud bursting process looks like when there is a large number of users accessing a cloud-based application.

When using cloud bursting, an organization should keep its level of security, along with any platform compatibilities and [compliance](https://www.techtarget.com/searchdatamanagement/definition/compliance) requirements, in mind. Because private clouds are generally more protected than public clouds, critical applications or data are not recommended for cloud bursting, since that data will transition between clouds.

**How does cloud bursting work?**

IT administrators help establish [capacity thresholds for applications](https://searchservervirtualization.techtarget.com/tip/3-tools-admins-can-use-for-private-cloud-capacity-planning) in the private cloud. When workload capacity nears its threshold, the used application automatically switches over into the public cloud and traffic is pointed toward it. Once the spike in resource demands diminish, the application is moved back to the private cloud or on-premises infrastructure.

An organization can take one of the following approaches to cloud bursting:

* **Distributed load balancing.** With distributed load balancing, applications operate between a public cloud and a data center. When traffic hits its predefined threshold, an identical environment redirects workload traffic to a public cloud. This method needs an application to be deployed locally and in the public cloud and requires load balancing operations to share traffic.
* **Automated bursting.** Automated bursting requires an organization to set policies to define how bursting is handled. Once set, an application hosted in a private cloud can automatically burst over into a public cloud. Software is used to automatically switch the application over. This helps an organization provision cloud resources exactly when needed without delay.
* **Manual bursting.** Manual bursting enables an organization to manually provision and deprovision cloud services and resources. Manual cloud bursting is suitable for temporary large cloud deployments, when increased traffic is expected or to free up local resources for business-critical applications.

**The benefits of cloud bursting**

The main benefits of cloud bursting include:

* **Cost.** An organization only pays for extra compute resources when needed. Likewise, private cloud infrastructure costs can be kept low by maintaining only minimal resources.
* **Flexibility.** Cloud bursting can quickly adjust to cloud capacity needs. It also frees up private cloud resources.
* **Business continuity.** An application can burst over into the public cloud without interrupting its users.
* **Peaks in traffic.** If an organization is expecting a sudden increase in traffic, like during a holiday, cloud bursting can be used to facilitate any expected or unexpected peaks in compute resource demands.

**The challenges of using cloud bursting**

Cloud bursting does not come without its challenges, however. These include:

* **Security.** If a public cloud is attacked, then an adjacent organization's data can be at risk.
* **Data protection.** It may be difficult to keep backups consistent when they are fed from multiple sources.
* **Networking.** Organizations may find it difficult to build low-latency and [high-bandwidth](https://www.techtarget.com/searchnetworking/definition/bandwidth) redundant connections between public and private clouds.

Other issues related to cloud bursting arise from the potential for incompatibility between the different environments and the limited availability of management tools. Cloud computing service providers and [virtualization](https://searchservervirtualization.techtarget.com/definition/virtualization) vendors have developed tools to send workloads to the cloud and manage hybrid environments, but they often require all environments to be based on the same platform. These challenges typically lead to few companies being able to deploy cloud bursting architectures.

**Cloud migration Additional points:**

**Cloud migration deployment models**

Enterprises today have more than one cloud scenario from which to choose:

* The public cloud lets many users access compute resources through the internet or dedicated connections.
* A private cloud keeps data within the data center and uses a proprietary architecture.
* The hybrid cloud model mixes public and private cloud models and transfers data between the two.
* In a multi-cloud scenario, a business uses IaaS options from more than one public cloud provider.

As you consider where the application should live, consider how well it will perform once it's migrated. Ensure there is adequate bandwidth for optimal application performance. Also, determine whether an application's dependencies may complicate a migration.

Review what's in the stack of the application that will make the move. Local applications may contain a lot of features that go unused, and it is [wasteful to pay to migrate](https://www.techtarget.com/searchcloudcomputing/feature/Move-to-the-cloud-without-blowing-the-budget) and support those nonessential items. Stale data is another concern with cloud migration. Without a good reason, it's probably unwise to move historical data to the cloud, which typically incurs costs for retrieval.

As you examine the application, it may be prudent to reconsider its strategic architecture to set it up for what could potentially be a longer life. A handful of platforms support hybrid and multi-cloud environments, including the following:

* Microsoft Azure Stack;
* Google Cloud Anthos;
* AWS Outposts;
* VMware Cloud on AWS; and
* a container-based PaaS, such as Cloud Foundry or Red Hat OpenShift.

**Cloud migration process**

The [cloud migration steps](https://www.techtarget.com/searchcloudcomputing/tip/12-key-steps-for-a-successful-cloud-migration) or processes an enterprise follows will vary based on factors such as the type of migration it wants to perform and the specific resources it wants to move. That said, common elements of a cloud migration strategy include the following:

* evaluation of performance and security requirements;
* selection of a cloud provider;
* calculation of costs; and
* any reorganization deemed necessary.

At the same time, be prepared to address several common challenges during a cloud migration:

* interoperability;
* data and application portability;
* data integrity and security; and
* business continuity.

Without proper planning, a migration could degrade workload performance and lead to higher IT costs -- thereby negating some of the main benefits of cloud computing.

Depending on the details of the migration, an enterprise may choose to move an application directly from local servers to its new hosting environment in the cloud without any modifications; this model is sometimes referred to as a [lift-and-shift migration](https://www.techtarget.com/whatis/definition/lift-and-shift). This is essentially a one-to-one move done primarily as a short-term fix to save on infrastructure costs.

In other cases, it might be more beneficial to change an application's code or architecture. This process is known as [refactoring an application](https://www.techtarget.com/searchcloudcomputing/tip/Key-considerations-for-refactoring-applications-for-the-cloud) or rearchitecting it. This can be done in advance of a cloud migration, or retroactively once it is clear that a lift and shift has reduced an application's performance.

IT management should consider whether refactoring an application makes financial sense. Calculate cost, performance and security when you analyze your ROI. An application likely will require at least some refactoring whether the transformation is minimal or comprehensive.

Enterprises have several choices when it comes to transferring data from a local data center to the public cloud. The type of data migration an enterprise chooses depends on the amount and type of data it wants to move, as well as how fast it needs to complete the migration.

One way to migrate data and apps to the cloud is through the public internet or a private/dedicated network connection. If you choose this method, be sure to calculate and provide the necessary bandwidth. For significant volumes of data, it may be unrealistic to sideline your internet connection, so be sure to plan accordingly to [avoid lengthy downtime](https://www.techtarget.com/searchcloudcomputing/tip/Good-cloud-migration-planning-helps-avert-downtime) during your cloud migration.

Another option is an offline transfer, in which an organization uploads its local data onto an appliance and then physically ships that appliance to a public cloud provider, which then uploads the data to the cloud.

In some cases, it might make more sense simply to use a truck to transfer large volumes of data. Major providers -- Microsoft, AWS, Google and IBM -- all offer services for offline data shipping. Physical shipment may not eliminate the need for additional syncing, but it can cut time and expense to move the data.

**What are the challenges of a cloud migration?**

A solid strategy won't completely eliminate all the hurdles and [potential problems with a cloud migration](https://www.techtarget.com/searchcloudcomputing/tip/Prepare-for-these-4-cloud-migration-problems). Sometimes IT leaders discover that their applications don't work as well in the cloud as they did on premises. They need to determine the reasons for the [cloud migration failure](https://www.techtarget.com/searchcio/feature/Cloud-migration-failures-and-how-to-prevent-them); it could be poor latency, concerns about security or perhaps compliance challenges. Often, the cloud application has a higher cost than anticipated or it does not work as well as originally an**ticipated.**

**There's another reality to acknowledge: Not every application is a good fit for the cloud. Managers must scrutinize their on-premises applications when they make their initial choice about which should move to a cloud environment**.

An often overlooked aspect of a cloud migration plan is to have a **solid cloud exit strategy, where the apps and data move out of the cloud and are returned to their original state on premises or**[**to a private cloud**](https://www.techtarget.com/searchdatacenter/tip/Essential-private-cloud-migration-steps)**.** IT managers must consider where the data will go, how to manage the technical transition and how to address any business or legal issues that may arise. Be sure to test the app before and after the repatriation, just as with the initial migration. If the app was altered to accommodate specific cloud benefits, such as horizontal scaling, those benefits would be lost when the app comes back on premises.

Many cloud migrations that fail are reversed only temporarily. They can be reassessed, possibly rearchitected rather than a lift-and-shift rehosting, and then sent back into the cloud with higher probability of success. Consider the changes you made prior to when you moved the application to the cloud. Moving the app back to its original platform might be one option.

Another common mistake made by **cloud administrators is setting up the wrong instance type.** You need to select the right amount of CPU and memory resources, as well as enough network connectivity for your chosen storage and app data transmission.

Don't underestimate proper **staff training.** Managing apps in the cloud is unlike working with local data centers and routine virtualized resources, and thus requires a different set of IT and management skills. In particular, data security requires a different approach in the cloud than on premises. Staff training needs to be a priority. Consider employee skill sets, and make sure everyone is properly trained on how to control and manage the relevant services. If staff cannot be trained prior to a cloud migration, it makes sense to hire an experienced AWS partner to manage the project.

**Data Migration in Cloud:**

## Defining data migration

In general, data migration means **moving digital information. Transferring that information to a different location, file format, environment, storage system, database, datacenter, or application all fit within the definition of data migration.**Data migration is a common IT activity. However, data assets may exist in many different states and locations, which makes some migration projects more complex and technically challenging than others. Examples of data assets include:Unorganized assortments of files stored across many different devices.Applications, operating systems, and environments.Relational databases like SQL Server, MySQL.As a result, data migration projects require planning, implementation, and validation to ensure their success.

Planning a data migration

Before even beginning to gather requirements for and scope a data migration, organizations need to start by discovering and assessing what data they actually have. They must map the data—find out how much of it there is, how diverse it is, and what quality or condition it is in.

They'll likewise assess the impact of the migration on the organization, establish who the stakeholders are and who has relevant expertise, assign responsibilities, set budget and timelines, and agree on how everyone will communicate about the data migration project.

After scoping the project, teams then design the migration, which includes selecting data migration software and hardware they'll use when they move the data, creating specifications for the data migration, and determining the rate at which they will migrate the data: all at once, just a little bit at a time, or anywhere in between. Many organizations seek help and guidance [right-sizing their migration](https://azure.microsoft.com/en-us/products/azure-migrate/)—especially when moving to the cloud.

Implementing a data migration

When planning is complete and the migration is designed, teams begin implementation. They build the data migration solution according to the requirements and [step-by-step migration guidance](https://docs.microsoft.com/en-us/data-migration) set forth in the planning phase and begin transferring the data.

As the data migrates, teams monitor and test it to ensure the data is transferring properly and free of conflicts, data quality problems, duplicates, and anomalies. This monitoring and testing take place in an environment that mirrors the production environment and enables teams to quickly identify and remediate any issues with the data migration.

Validating a data migration

After all the data has been migrated and implementation is complete, teams will audit the data in its new configuration and validate that the data has been transferred accurately. Teams take the old data configuration out of service only after the data migration is validated by technical and business stakeholders as well as anyone else—including customers—who might use the data.

An organization may need to or choose to migrate data for many different reasons. At a high level, these reasons can include reducing costs, enabling innovation, increasing performance, creating higher availability, and strengthening security. As organizations make the decision to migrate data, they'll need to consider the integrity of the data, the cost of migrating, and the impact to the business and its customers.

## Some specific scenarios and business cases that may require data migration include:

* Upgrading or replacing legacy hardware or software so the organization can meet its performance requirements or be more competitive.
* Lessening environmental impact—and decreasing operational costs—by moving to a system that has a smaller footprint and uses less energy.
* Reducing or eliminating the expense of hosting the data in on-premises datacenters by migrating to the cloud.
* Centralizing data to enable and facilitate interoperability or relocating to a more secure datacenter.
* Backing up data to allow the organization to better prepare for and execute disaster recovery.

Organizations that need to migrate data as part of a modernization effort often seek [expert advice and help](https://azure.microsoft.com/en-us/solutions/migration/migration-modernization-program/) setting up their cloud environment and guiding their migration end-to-end.

## Types of data migration

While every data migration project is different according to the systems and data involved as well as the organization’s objectives, data migration can be classified into these five broad categories:

* [Storage migration](https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-data-migration/#storage-migration)
* [Database migration](https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-data-migration/#database-migration)
* [Application migration](https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-data-migration/#application-migration)
* [Cloud migration](https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-data-migration/#cloud-migration)
* [Business process migration](https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-data-migration/#business)

These are not the only types of data migration, and a data migration project can include several types of data migration. For example, if an organization decides to move data from an on-premises server to a server operated by a cloud provider, that project might constitute a cloud migration and a database migration. The five categories are helpful because they provide a general outline of data migration scenarios and the reasons an organization may undertake that particular type of data migration.

## Storage migration

Storage migrations are the most basic types of data migration, fitting the literal definition of data migration. These migrations consist of moving data from one storage device to a new or different storage device. That device can be in the same building or in a different datacenter that's far away. The device may also be of a different kind, such as moving from a hard disk drive to a solid-state drive. Migrating data to the cloud or from one cloud provider to another is also a kind of storage migration, though the specifics of those types of data migration are better understood as cloud migrations.

Organizations may choose to do a storage migration when they find the need to upgrade their equipment or infrastructure to achieve faster performance or save money on scaling. The new technology may also enable the organization to manage, secure, back up, or recover data more effectively. During a storage migration, organizations also have the opportunity to clean and validate the data, though it is less often that organizations opt to change the format of the data during this type of data migration.

## Database migration

This type of data migration often requires data conversion because database migrations typically involve moving large amounts of data to an updated or different database engine or database management system. Database migrations are more complex than storage migrations because not only is more data being transferred, but that data is likely changing in format too.

Database migrations may become necessary for organizations when they need to upgrade their database software, migrate a database to the cloud, or change database vendors. Before migration begins, teams must ensure there's proper capacity for the database and test to make sure that there will be no impact to the applications that use the database.

## Application migration

An application migration involves moving data to a new computing environment. This type of data migration is an example of a data migration that combines several others. Migrating an application may require both database migrations and storage migrations. The database that the application uses will need to be relocated—sometimes even modified in format to fit a new data model via data conversion—along with the files and directory structure the application requires to install and run.

Organizations may carry out an application migration when there is a change in the software the organization uses to perform a business function, the vendor that provides the software, or the platform where the software resides.

## Cloud migration

Much like two other types of data migration—storage migration and application migration—this type of data migration involves moving data or applications. The key aspect is that cloud migration refers specifically to transferring data or applications from a private, on-premises datacenter to the cloud or from one cloud environment to another. The extent of the migration will vary. A cloud migration may involve moving all data, applications, and services to the cloud, or it may entail moving just a select few to meet a strategic purpose or business need.

Migrating to the cloud enables organizations to scale with fewer limitations, provision resources more readily, upgrade with less fiction, spend more effectively, and innovate more rapidly. With their data and applications residing in the cloud, those organizations are no longer required to maintain the machines and infrastructure that were storing those assets on-premises.

## Business process migration

This data migration type refers to moving data and applications in order to better manage or operate the business itself. In a business process migration, the organization may transfer any kind of data—including databases and applications—that serves products, customer experiences, operations, practices.

Organizations may undertake this type of data migration to optimize or reorganize how the business is run, to better compete in the market, to offer a new product or service, or to complete a merger or acquisition.

* 1. **5 Quality of Services in cloud Computing**

QUALITY OF SERVICE (QOS): Users of internet networks are increasing day by day, network requirement also increases to achieve good performance. Therefore, many online services need a very large bandwidth and network performance. Network performance is the element that disquiet the users and service providers. Internet service providers should bring new technologies to provide the best services before competitors strike them. Quality of Service refers to the ability of networks to attain maximum bandwidth and handle other network elements like latency, error rate and uptime.

Quality of Service includes the management of other networks resources by allocating priorities to specific types of data (audio, video and file).

Basic implementation of QoS need three major component:

a. QoS within one network element.

b. QoS policy and management functions to control end-to-end traffic across the network.

c. Identification techniques for coordinating QoS from end-to-end between network elements.

Cloud Computing: Cloud computing, the old dream of computing, became true recently. It has the potential to transform a large part of the IT industry and make software having qualities as a service . Many cloud-computing operators are now active in the market, providing good services including Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) solutions. Cloud computing is a type of computing that deals with shared computer resources and data to provide the data for a large number of users over the internet network. Cloud computing has strong points that make it better than the normal computing system like

**Mobility, mobility term means that spreading service in a wide space means that you can use this service from anywhere you have access to the internet.** You can access your documents you uploaded to cloud storage services like Drop Box.

**More Storage**, initially, memory storage was limited. When you ran out from memory, some functionality of your software will not work properly. You also need to get USB drive to back up your current files. Cloud computing provides increasingly storage, so you will not be worry about running out of space on your memory.

**Easy Set-Up,** Setting up cloud computing service would done in a few of minutes. Adjusting your setting, choosing password for your network or service is very simple. After that, you can immediately start using your service and data.

**Automatic Updates,** Cloud computing providers are responsible to provide updates and make it available, you just need to download and install them. This does not need you to be expert to update your device; cloud-computing providers will notify you when updates area available and will give you instructions to ease this process for you.

**Cheap Service,** Cloud computing is inexpensive comparing to the other memory storage. The software already installed online, so no need to install it by yourself. Many cloudcomputing providers provide spaces free like Drop Box. As there is strong points, there are some weak point in cloud computing, for example Security, when you are using cloud-computing services that mean you essentially handing over your service and data with third party. As well as many users from different places in the world are accessing the same server can access security issues. Privacy, Cloud computing comes with the risk that unauthorized users might access your information. To protect against this happening, cloud-computing services offer password protection and operate on secure servers with data encryption technology. Internet Reliance, While Internet access is increasingly widespread, it is not available everywhere just yet. If the area that you are in does not have Internet access, you will not be able to open any of the documents you have stored in the cloud. Loss of Control Cloud computing entities control the users. It include what information you can store in your cloud, places where you can access your information. Everything depend on cloud-computing providers for update and backups. Nevertheless, suppose for some reasons, their server fall down, you will face the risk of losing all your data .

**Techniques to Provide QoS of Cloud Application:** As we explained before about the QoS, it is a challenge to implement QoS in cloud computing applications. There are many techniques to provide quality of service to the cloud applications. **Scheduling, admission control and dynamic resource provisioning** are some techniques used to achieve that goal.

**1- Scheduling: Cloud service scheduling categorized into two categories: user level and system level.** At user level scheduling deals with problems raised by service providing between both service provider and customer. Market based and auction based schedulers are fit for ruling the supply and demand of cloud resources. Market based resource allocation is powerful in cloud computing environment where resources are handed over to user as a service. The system level scheduling handles with resource management in datacenter. Datacenter contain many physical machines, Million request sent from user’s side, scheduling these requests to the physical machines done in datacenter. This scheduling affect the performance of datacenter.

Service provisioning in cloud systems based on Service Level Agreement (SLA). SLA is the contract between service provider and customer mentioning the terms of agreement including the nonfunctional requirement represented as QoS.

**2- Admission Control:** The main purpose of admission control is **to provide strong performance.** At admission control time, the Infrastructure Provider (IP) must consider the extra requirement along with the fundamental computational and networking necessities that may be required to be added to runtime so it become flexible. In many cases, these flexible requirements may be very large comparing it to the normal requirements. For example, if there are many users are working on cloud application with high divergence, the number of virtual machines are required more and that may be added at runtime many times multiple of the number of the basic ones. So that, the number of flexible requirements plays important role in the total requirements and therefore the cost of hosting the service.

**3- Resource provisioning:** Dynamic resource provisioning is the process of assigning available resources to the cloud application. Resource allocation will make services suffer if the allocation not managed in the right way. Resource provisioning will solve this problem by allowing the service providers to manage the resources of modules individually. Resource Allocation Strategy (RAS) is all about integrating service provider services activities to allocate insufficient resources within the limit of cloud environment so that it meets the needs of the cloud application. It need the demand and type of resources for each application to complete the user task. The order and allocation time for resources are inputs for optimal RAS.