Microsoft

Cloud migration essentials

A guide to migrating servers and virtual machines

Contents

Introduction

In recent years, global business has witnessed significant cloud adoption, which provides considerable value over traditional datacenters—achieving greater scalability, cost efficiency, and improved performance.[1]

Many organizations now want to quickly take advantage of the benefits of the cloud by migrating their existing applications and workloads. However, cloud migration requires careful planning and strategy.

To enable successful migration, it's important to have a strong plan in place that covers the end cloud environment, training, and—most importantly—the readiness of your workloads and applications.

This means you need to determine how to:

Create the initial technical plans and business justification.

Ensure your workloads will run as expected.

Perform the migration with limited impact to the business.

Then, once you've migrated to the cloud, you need to make the most of your investment and keep it secure.

If you're an IT manager running on-premises applications and servers, this guide can help you start your migration to the cloud.

[1]By migrating to the cloud, you can save more than 80 percent over the total cost of running a traditional solution on-premises. See Migrating VMware to Microsoft Azure: Total cost of ownership guidance

In this guide, you'll discover:

- ✓ Preliminary steps to consider when looking at migration.

- ✓ Various approaches for rehosting, refactoring, rearchitecting, and rebuilding your workloads for the cloud.

- ✓ Some tools you can use to accelerate your migration project.

- ✓ Tips for post-migration success.

Migrating to the cloud doesn't have to be difficult. With the right tools and processes, your migration project can be fast and friction free. Methods such as lift and shift can rapidly move you to the cloud, reducing costs immediately and allowing you to focus on future cloud modernization. In addition, processes for assessment, optimization, security, and management can help throughout your continuing adoption of cloud resources.

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[2] Read the customer story.

"One of our big objectives was to eliminate \$3 million in capital costs over about three years, and to reduce our operating costs by approximately the same amount. At the same time, we wanted to improve our quality of service. With Azure, we're confident that we'll meet those goals."

Jim Slattery, Chief Financial Officer, Capstone Mining[2]

Why migrate now?

At first glance, migration might seem like a technical decision, but its core is business related. Ultimately, it raises two fundamental questions: What's driving your business to migrate to the cloud, and why now?

The benefits of the cloud are universal—reduction in running costs, faster modernization capabilities, and increased security. But there's usually a specific catalyst for starting the migration discussion. These can include:

Operational efficiencies and reduced operating expenses. With reduced hardware support, increased manageability, and more efficient processes, you can save an average of 20 to 30 percent on VM resource configuration alone.[3]

Decreased time to market/release. By reducing management overhead and freeing up budget, you can focus more time and effort on rapid software and solution development. Faster deployment of Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) platforms enables your business to release faster and more often.

Support for cost-effective scalability requirements. When you plan for peak usage through on-premises systems, your servers are usually running at less than 20 percent utilization. The cloud releases you from this model, enabling a scale-when-you-need-it approach.

Renewal of datacenter or hardware leasing. If you're currently extending your budget on renewing hardware or paying for datacenter locations, it's a good time to consider cloud migration. A cloud vendor can host these services for you, eliminating the need for costly leasing.

Renewal of licensing. Nearly all companies have an annual licensing agreement with their major IT providers. These require ample budget to ensure the OS platform and virtualization are sufficiently covered. The cloud can help here as well, providing a pay-as-you-go offering to reduce this cost.

Application development and modernization. Two common challenges for today's businesses are over allocated IT resources and on-premises platforms that limit the adoption of modern services. The cloud provides an integrated platform for modern development that enables teams to increase speed by up to 33 percent.[4]

Software end of support. End of support for Windows Server 2008 and SQL Server 2008 means the end of regular security updates. This can be an opportunity to migrate your end-of-support workloads to Azure to strengthen your organizational security posture and ensure compliance across your hybrid environment.

Support for SQL Server 2008 and 2008 R2 ended on July 9, 2019.

Support for Windows Server 2008 and 2008 R2 ends on January 14, 2020.

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[3] VM sizing calculations from the Microsoft Azure TCO calculator.
[4] The Shift to SaaS: A high-value opportunity for ISVs.

Ultimately, by migrating your current environment to the cloud, you're putting yourself in a better position to accelerate your business. By reducing costs and making management more efficient, a cloud platform can immediately influence your IT group's ability to invest back into core strategic projects, increasing security and reliability while advancing application development.

Simplify and accelerate your move to the cloud

The Azure Migration Program is designed to help you streamline cloud migration for your company. Work with Microsoft experts and specialized partners to achieve value faster, with full access to curated guidance and best practices based on proven cloud adoption methodologies.

Through the Azure Migration Program, you'll be able to:

- Implement your migration with curated guidance

- Lead your company's cloud journey with technical resources and training

- Access free Azure tools to migrate infrastructure, databases, and applications

- Optimize your cloud costs with cost-management programs and tools

Sign up ›

How do you approach migration?

Your cloud migration strategy will depend on many factors: What are your most pressing needs? What are the skills on your team? Where are your apps in the development lifecycle?

Migration strategies generally fall into one of five categories [5] (Figure 1).

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[5] Five Options for Migrating Applications to the Cloud.
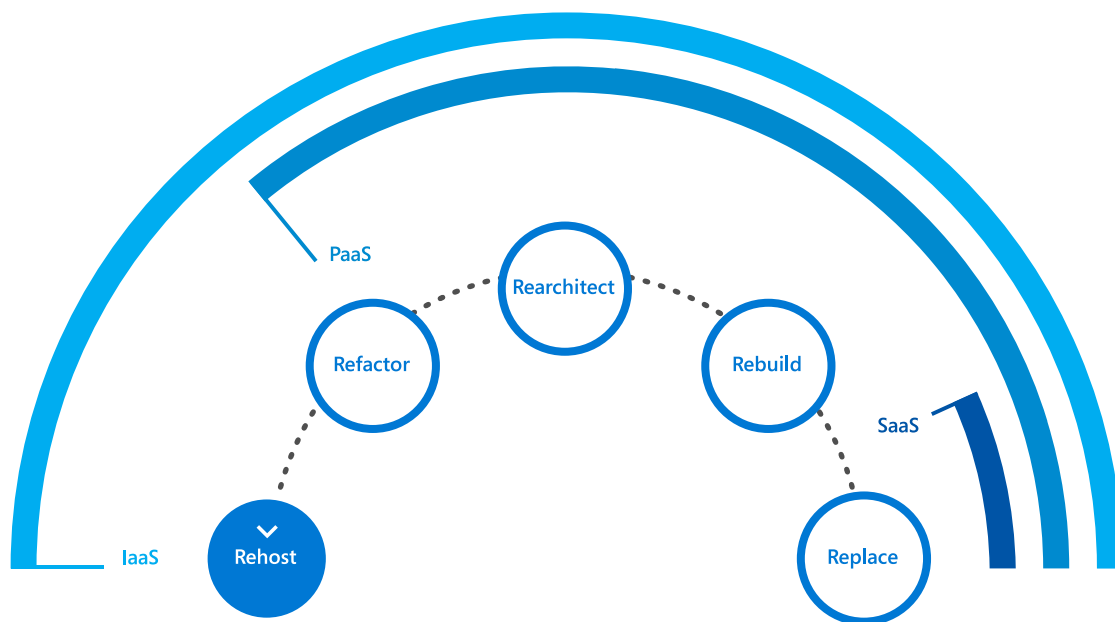
Figure 1. Five categories of migration strategies.

Rehost

Also known as "lift and shift," this strategy entails migrating your physical servers and VMs to the cloud just as they are. (Figure 2.)

By simply shifting your current server environment straight to IaaS, you reap the benefits of cost savings, security, and increased reliability.

In the new rehosted cloud model, hardware and OS you previously managed yourself are now managed by the cloud provider. All other aspects of the workload or application remain the same. This is a highly popular migration approach because it lets organizations move quickly with little risk or impact and receive immediate benefits. It also allows organizations to see lower TCO faster, enabling investment back into the migration process that can then evolve through the model.

Remains same	App and Data	Managed by customer
	Code / Runtime	
	App Configuration	
	App Platform / Middleware	
	OS	
	Virtualization	Managed by cloud provider
	Hardware	
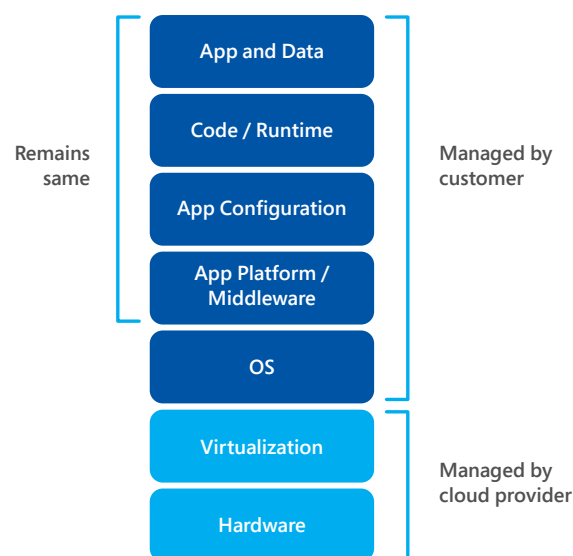
Figure 2. Rehost.[5]

Refactor

This strategy involves using additional cloud provider services to optimize cost, reliability, and performance by refactoring your applications. (Figure 3.)

In rehost, you only use provider-managed hardware and OS, but in this model, you also take advantage of cloud services to drive down cost. You continue to use your current application as-is, with some minor application code or configuration changes, and connect the app to new infrastructure services like Azure App Service, Azure SQL Database Managed Instance, and containers. By employing modernized services, you can reduce both cost and management.

Updated	App and Data	Managed by customer
	Code / Runtime	
	App Configuration	
	App Platform / Middleware	Managed by cloud provider
	OS	
	Virtualization	
	Hardware	

Figure 3. Refactor.[5]

Rearchitect

This strategy involves rearchitecting an application to modernize it—that is, to transform it with a modular architecture. (Figure 4.)

Rearchitecting is modifying or extending an existing application's code base to optimize it for a cloud platform and better scalability.

Cloud provider services can be used directly as backend services of modern apps, which are highly scalable and reliable. This is likely the most time-consuming way to migrate an app to the cloud because it requires app code changes. One example of rearchitecting would be decomposing a monolithic application into Microservices that work together and readily scale on Microsoft Azure. Another example would be rearchitecting a Microsoft SQL Server database to make it a fully managed Azure SQL Database.

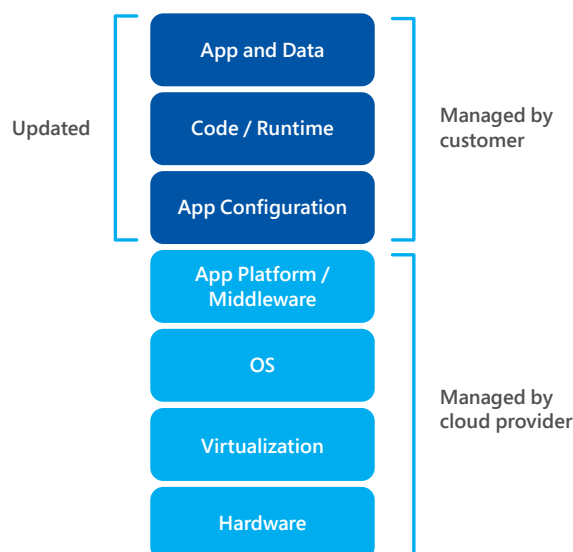|	
App and Data	Managed by customer
Code / Runtime	
App Configuration	
App Platform / Middleware	Managed by cloud provider
OS	
Virtualization	
Hardware	

New/Updated
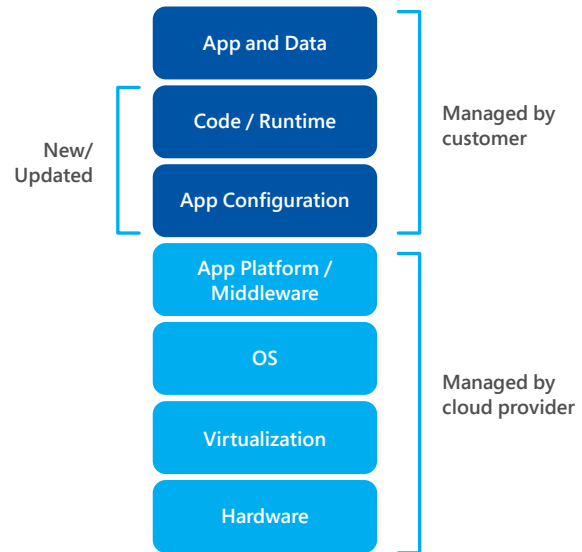
Figure 4. Rearchitect.[5]

Rebuild

This strategy involves revising the existing application by aggressively adopting PaaS or even Software as a Service (SaaS) services and architecture. (Figure 5.)

The process encompasses major revisions to add new functionality or to building the app from scratch the application for the cloud. An example of rebuilding would be redesigning code to decompose the original application into smaller chunks, and then deploying using cloud-native technologies.

App and Data	Managed by customer
Code / Runtime	
App Configuration	
App Platform / Middleware	Managed by cloud provider
OS	
Virtualization	
Hardware	

New / Transformed

Figure 5. Rebuild.[5]

Replace

This strategy involves moving or discarding an existing application and replacing it with commercial software delivered as a service. (Figure 6.)

SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider. When you choose this option, all underlying infrastructure, middleware, app software, and app data are managed by a service provider and located in the service provider's datacenter. The service provider manages the hardware and software and, with the appropriate service agreement, ensures the availability and security of the app and its data. SaaS can help your organization quickly launch an app at minimal upfront cost. Typically, you migrate existing data to the SaaS environment and import/export application data with an API or configuration/admin console.
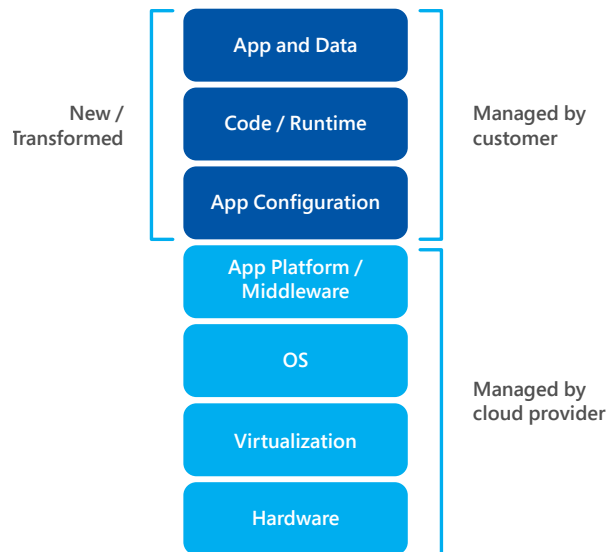
Transformed

App and Data

Code / Runtime

App Configuration

App Platform / Middleware

OS

Virtualization

Hardware

Managed by cloud provider
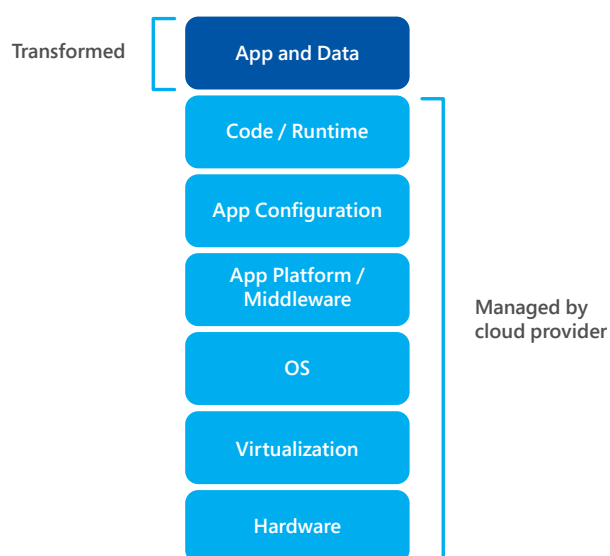
Figure 6. Replace.[5]

Lift and shift is the most common (and fastest) first strategy, enabling you to move quickly to the cloud. By understanding your business processes, you can easily map the next best strategies for each workload based on goals, effort, and complexity. An advantage of this approach is that it enables you to sustain parallel migration efforts. And, as your migration projects continue, you can easily start modernizing certain applications to PaaS and even SaaS options.

You can start with any of the cloud migration strategies depending upon your existing workloads and cloud adoption path. Workloads can evolve over time, potentially you can define a step-by-step journey for moving workloads from on-premises to the cloud, where you begin depends on the complexity of the workload and, ultimately, what you want out of it. For example, if you have a simple web application hosted in Windows Server Internet Information Services (IIS) and connected to a database, it might make sense to proceed directly to cloud optimization. In this case, you could migrate the application to Azure App Service and Azure SQL Database. To do this, you'd need to have a deep understanding of the application, including its complexity and dependencies.

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[5] Five Options for Migrating Applications to the Cloud.

Four steps to migration

No matter which strategy you choose, you need a solution that makes cloud adoption as smooth and easy as possible—one that lets you migrate at your own pace.

This requires a cloud provider (and core partners) that can deliver a comprehensive set of tools and methods to help ease migration and reduce overall risk. Most of all, this solution should offer a simple process that's easy to follow. With these goals in mind, Microsoft recommends a four-step migration process for moving to the cloud.

Assess. Discover and assess your on-premises resources, such as applications and workloads, to plan where your Azure migration should start.

Migrate. Move resources using powerful, free tools while minimizing downtime.

Optimize. Streamline your cloud resources, improve performance and ROI, and stay compliant.

Secure and manage. Ensure security and fine-tune management of your cloud environment.

With this straightforward framework, you get a proven approach to migration. This process provides a clear picture of your entire application and workload portfolio, the best way to configure that portfolio to achieve migration, convenient tools to ensure low-impact transfer, and ongoing performance and cost optimization.

But before migration begins, how do you ensure that your virtual datacenter in the cloud is ready to receive your workloads? As you're planning to run your most critical applications there, you want to be confident that your cloud foundation is solid. If you already have workloads or DevTest running in the cloud, you might have an environment and connectivity ready to go. However, if you're new to the cloud or only have a basic setup, you'll need to perform a few steps before migration.

Before you migrate

Before migration, you need to build a virtual datacenter in your cloud, including connectivity, networking, storage, and identity—elements comparable to your on-premises environment. By establishing this virtual datacenter, you can ensure that your applications will continue to support your business after migration, without surprises.

Building your virtual datacenter is a streamlined process because you can use components available in the cloud for quick assembly and configuration. You can take advantage of many excellent tools and guidance to help accelerate this step, but below are some of the basics—and why they're essential to migration.

Identity

As in your on-premises environment, you need a way for users to be identified and authenticated to ensure secure access to your new cloud resources. Having the right identity solution can help you protect your applications and data and defend against malicious login attempts without disrupting productivity. Cloud providers offer built-in identity solutions as a service, like Azure Active Directory, or you can choose an independent solution. Make sure that your cloud identity solution integrates with your on-premises identity system. Because your workloads will now be stored in the cloud, you'll want seamless access for users between your existing on-premises systems and the systems you've migrated. A cloud-based identity management solution connected to your on premises environment can help to ensure a positive user experience——while also supporting your organization's growth into more advanced cloud services.

Storage

Another necessity in the cloud is a storage platform that will meet the expected performance needs of your migrated workloads. On-premises, this storage is usually through NAS- or SAN-based systems. In the cloud, virtual storage provides wide range of storage options—managed disks, file storage, object storage, archive storage, big data storage and more.

Fortunately, you can choose among many storage types to guarantee reliable performance, including performance and access levels, backup, geographical replication, and disaster recovery. Working with a virtual storage platform also gives you a finer degree of control and configuration. You can easily configure exact storage requirements for each workload as needed, without having to worry about the physical architecture. Azure even offers managed storage, which takes the pain out of storage configuration. It requires you to enter just a few details before acquiring up to thousands of secure, reliable, and available disks for your migration project.

Networking

Networks are crucial. They are the symbolic backbone of the datacenter. Moving to the cloud requires a new way of networking since you're no longer reliant on physical topology. In fact, you can now overcome physical boundaries with a single subnet, which simplifies networking communication.

When moving applications from on-premises to the cloud, you might want to keep them in the same networking subnets and even IP address ranges to ensure a seamless migration. Virtual networking can support this and merge with your on-premises physical networking architecture as needed. This ensures that your applications can continue to use the network topology they were built upon, further easing migration.

Connectivity

During migration, you're going to move vast amounts of data. However, you'll still be moving data even after the bulk of your critical workloads are hosted in the cloud. As such, you should consider a more dedicated connectivity option to help with data transfer and the ultimate end-user experience.

You might currently have virtual networks set up, possibly using these over the internet or site-to-site VPN to connect to your cloud environment. While this works well for smaller deployments, you'll need a new approach to run an entire enterprise both during and after migration.

Azure ExpressRoute is one compelling service to use for connectivity. It ensures both performance and security—especially in the initial heavy lifting of VMs to Azure, which involves considerable data flowing across the wires. ExpressRoute enables a faster, private connection to Azure.

Azure Data Box is another option for migrating large amounts of data—especially when you're limited by time, network availability, or cost. Azure Data Box is a physical device that you connect to your network and load your data into by using standard NAS protocols. Then you simply send your data to Microsoft through a delivery transport service, and it will be securely loaded into your Azure environment.

Readiness

While many core management skills are useful in the cloud, there are some key skill differences, so your team will need to get up to speed on some new tasks. However, training takes time away from performing core duties, can be costly, and often doesn't properly build on what people already know.

Microsoft Learn can help solve these challenges with unique learning paths focused on job roles. This readiness tool offers simple online training in bite-sized pieces, practical labs, and assessments to test knowledge. It's a fast way for your team to grow their skills, and, best of all, it's free.

Ready to migrate

Now it's time to begin your migration journey to the cloud! This e-book focuses on a migration process in which you move the bulk of your applications and workloads running on-premises to Azure Virtual Machines (and plan to modernize after the move has been performed). The environment in this scenario is set up in Azure with Azure Active Directory (linked to on-premises Active Directory) for identity management, with managed disks ready to receive the data and virtual networks deployed.

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Assess

When beginning a migration, you first need to get a better understanding of what your applications are, how many servers and/or VMs you have, and how you'll plan to move components to the cloud.

Uncertainties about the total savings and perceived complexity can get in the way of taking this step. Many organizations have found that moving existing workloads to Azure can yield significant benefits. Justifying the investment requires confidence that you'll save a significant amount on operational costs and that your current workloads will work as expected in the cloud.

Many workloads can run immediately on Azure without modification, while other workloads that have operational and application dependencies in an on-premises environment require further analysis and planning. If your applications are composed of multiple servers or VMs, you should invest in consolidated planning to identify them and shift them to the cloud. This is not a manual process, and you'll need intelligent planning tools to do it. Similarly, getting accurate cost comparisons can be challenging when you're estimating the load and Azure VM instance. Without automated analysis to map on-premises capacity to VM instance, your estimations might fall short—causing performance issues. Or your estimations could be too high—stretching your budget.

"We don't want to be in the datacenter business; we're in the thread business. We plan to move 90 percent of our global datacenter infrastructure into Azure, and we're at about 75 percent now. The only things we'll leave on-site are a few domain controllers and file/print servers."

Richard Cammish, Chief Information Officer, Dillon Gage[6]

[6]Read the customer story.

Assessment Plan

Technical and business planning for migration comes down to four straightforward steps. (Figure 7.)
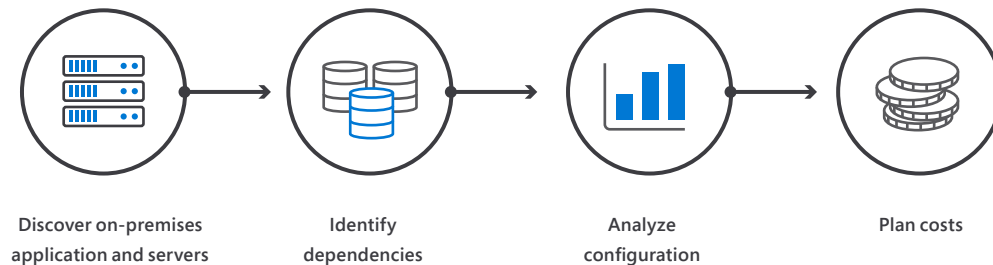

Figure 7. Technical and business planning for migration.

Discover on-premises applications and servers

It's likely that your organization runs hundreds—if not thousands—of servers and VMs. While your current management tools might have a good representation of these, to kickstart any migration, you'll need an assessment mechanism that can feed data into subsequent steps.

Discovering servers and VMs is usually a straightforward process. It relies on interaction directly with the endpoint (using an agent) or managing hypervisor (such as VMware vSphere or Microsoft Hyper-V).

Ultimately, the goal of the Assess step is to collect server and application information, including type, configuration, usage, and applications that might be running.

Identify application and server dependencies

Once discovery is complete, you'll need to map any dependencies or communication between your servers (and applications). This is critical because when migrating an application, you need to know all the servers and processes the app is using.

Many tools provide server dependency mapping but don't provide application dependencies. To ensure a full picture of all communication among workloads, you need a tool that will perform both. This will allow you to create visual maps of all your applications and workloads, which enables their interaction as a single entity for costing, configuration analysis, and eventually migration.

Analyze configuration

The Assess step enables you to ensure that each workload will function on your cloud platform. Through the collection and analysis of data, the assessment tools can give you metrics on the compatibility of the workload in the cloud. For example, is the OS that the workload runs on supported? Or are there specific hardware dependencies that might not be replicated in a cloud environment (such as running a UEFI boot on a disk that's larger than 4 TB)? Configuration analysis should show you workloads that will migrate with no modifications, those that might require basic modifications, and those that are not compatible in their current formation, as well as provide guidelines to remediate potential issues or recommend configuration changes.

Plan costs

The final piece of the Assess step is collecting resource usage reporting (such as CPU, memory, and storage). This is important because on-premises VMs are often overprovisioned but utilized under 20 percent. If you were to take the physical configuration of your on-premises server and map this to an Azure VM series type, you'll likely find that you're paying for more performance and scale than you need.

Because the cloud is costed as a usage model, you should ensure your choice meets both performance and economic targets. The goal in any cloud model is to drive your VMs to at least 90 percent utilization, while making sure you meet performance and reliability goals. Through historic resource analysis, intelligent cost analysis tools can determine the actual usage of your workload and suggest the best cloud Azure VM series to use.

Tools for assessment

Many tools in the Azure ecosystem can help tackle the above needs simultaneously. As part of the Azure subscription for all customers, Microsoft provides Azure Migrate, which offers automation for the Assess step. Azure Migrate is a great fit for organizations that have virtualized servers in VMware. Organizations that have servers in other environments should take advantage of assessment tools from the Azure migration partner ecosystem.

These tools can also help you gather on-premises usage characteristics like CPU, memory, and storage and map them to their Azure equivalents, giving you the technical and business reporting needed to continue your migration plans. Using these tools can help you maximize the benefits of moving to Azure, as well as identify where programs like Azure Hybrid Benefit best fit into your migration to save you more money.

For more information about assessment tools, explore these resources:

Azure Migrate. Take advantage of discovery, assessment, guidance, insight, and mechanisms for cloud migration through this free integrated Azure service. Learn more about Azure Migrate.

Azure migration support. Accelerate your migration with experienced assessment partners, which provide many options for your unique environments. Learn more about Azure migration support.

Pay less with Azure. Achieve the lowest cost of ownership when you combine the Azure Hybrid Benefit, reservation pricing, and extended security updates. Amazon Web Services (AWS) is five times more expensive than Azure for Windows Server and SQL Server. Learn more about Pay less with Azure.

Migrate

Once you've completed your assessment, it's time to prepare for the next step: cloud migration.

This is when, after you've decided on your migration goals and gathered all requirements and constraints, you can choose the best method of migration.

Earlier in this e-book, we described the strategies that you can use for migration—progressing from rehosting your apps, to refactoring and rearchitecting, and finally to modernization by rebuilding or replacing apps. In the Migrate step, you'll determine the strategy that best meets your requirements—and this is usually best addressed on a per-application basis. In this step, you're essentially physically moving your workloads and applications (including their data) to the cloud and planning to retire the on-premises versions. Every organization will have a different approach, and you might mix rehosting, refactoring, rearchitecting, rebuilding, and replacing your applications.

This e-book focuses on the rehost strategy—moving applications running on traditional servers and VMs to Azure IaaS. In many cases, organizations will start with lift and shift to drive rapid migration and early cost savings. Lift and shift requires no change in an app or workload framework or architecture; it simply means hardware and OS are managed by the cloud provider. This approach requires confidence regarding two key issues: Can you easily migrate a workload without too many manual steps? And will the workload function as expected in the cloud? As such, several decision points come into play based on what's being moved and especially how (or if) you want to access it while the migration is taking place.

The lift-and-shift method most often employed for server or VM migration is real-time replication because of its flexibility and support for a staged migration. Real-time replication allows the workload to remain online and accessible during the migration. Plus, modern tools enable the system to cleanly migrate real-time data even when the system is actively being used.

Real-time replication

Real-time replication involves setting up a copy of the workload in the cloud and allowing asynchronous replication to keep the copy and the original in sync. (Figure 8.) This means that while you're building and executing your migration plans, any data or server updates are synced between the copies.

This model also enables groups of VMs to be connected, for example, for a multitiered application or workload. This is important for testing and the final migration cutover. When the system has a map of the connections and dependencies among VMs, you can create plans to ensure the VMs are bought up in the correct order when starting. For example, with a simple web app, your database source needs to be available before the application runtime begins.

Using your assessment plans as a guide—and your migration tool of choice—you can configure each VM to replicate to the correct VM instance in your cloud provider. This is also when you should define the storage and network connections that you set up initially when creating the environment. Most tools have a mechanism to define the replication timeframe (usually between 30 seconds and 15 minutes). This timeframe is based on your network capability and latency.

Many tools also support application-aware replication automatically. Microsoft applications (such as SharePoint, Dynamics, SQL Server, and Active Directory) and apps from other vendors (including Oracle, SAP, IBM, and Red Hat) can be migrated with application-aware replication, which ensures the source data consistency before replication. Initial replication is also bandwidth intensive, and mechanisms discussed earlier—like ExpressRoute and Data Box—can help you manage the bandwidth requirements of migration. It's something to consider when planning your migration timeline.
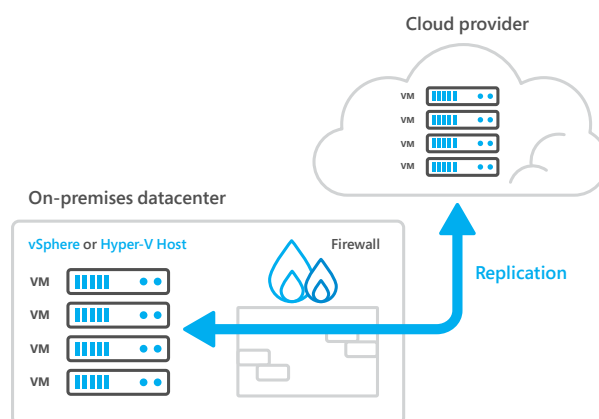

Figure 8. Real-time replication.

Testing

Testing is integral to ensuring system health before final cutover. Many migration tools have options that let you start up a set of VMs in an isolated environment, which allows you to mimic the production environment in the cloud. This means you can fully test the application without affecting the on-premises or cloud production versions. Once replication is complete, simply start your application or workloads using the isolated environment option, and take some time to test your startup script or runbook for errors. When you're fully satisfied that both function as expected, it's time to perform the final cutover.

Migration tools can also perform the final launch in your cloud and turn off the on-premises application. In some cases, you'll have to update DNS records for the new cloud-based workloads. However, if you migrated to use DNS in the cloud as part of your initial environment setup, this might happen automatically.

"To expand globally, we can simply clone the infrastructure that we have running in our US Microsoft Azure datacenter to Azure datacenters in Asia and elsewhere."

Tom Grounds, Chief Information Officer, Coats[7]

[7] Read the customer story.

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Tools for migration

Because migrating servers and VMs is unique for each organization, multiple tools are available to support specific needs. These range from Microsoft tools like Azure Site Recovery to various third-party tools. Third-party tools are valuable alternatives when you have needs that aren't covered by Azure Site Recovery. For example, while there are some OS types that Azure Site Recovery can't migrate, other partner tools can support these efforts.

Database migration is supported by the Azure Database Migration Service. By using the Database Migration Service migration workflow, you can move on-premise databases to Azure. Database Migration Service enables schema and data migrations from SQL Server to Azure, including migrations to SQL Server on a VM or to Azure SQL Database. Database Migration Service also supports to migrate databases running on MySQL and PostgreSQL to Azure Database for MySQL and PostgreSQL respectively. In addition, SQL Server Migration Assistant (SSMA) and Data Migration Assistant can help with database migrations.

Alternatively, you might have other needs, like rapid migration (migrating more than 100 VMs per day), for which normal replication might not be sufficient. In these cases, specific tools can assist you with migrating the runtime to Azure first while leaving the storage on-premises. Then, over time, the storage is replicated. Many tools can meet your unique migration needs. Customize your company's migration approach with help from the Azure Migration Program.

For more information about migration tools, explore these resources:

Azure Site Recovery. Migrate physical servers or VMs from on-premises to Azure. Azure Site Recovery supports custom replication timing, isolated testing, and final migration cutover. You can replicate and migrate VMs to Azure using rightsizing recommendations based on the Assess step, and take advantage of Azure Hybrid Benefit when the initial replication occurs (as a configuration option). This tool saves time because you don't need to go back and complete this effort for each VM. Learn more about Azure Site Recovery.

Azure Database Migration Service. Migrate your existing application database running on SQL Server, Oracle, DB2, MySQL or PostgreSQL to Azure as a VM, Azure Managed Instance, or directly to Azure SQL Database. Learn more about the Azure Database Migration Service.

Azure Migration Program. Reduce friction and accelerate your cloud migration with prescriptive advice and tools. Learn more about the Azure Migration Program.

Optimize

Once you've implemented your cloud migration strategy, you'll want to ensure that you're taking full advantage of the cloud's performance, scalability, and cost-saving benefits.

This will enable you to pay only for the services and resources you use, achieve a greater ROI, and receive additional savings by using the latest cloud capabilities. This is also the best time to start looking at new services for modernizing your application—migrating to PaaS and even SaaS, where applicable.

On-premises tools are not built for cloud scale and agility. Plus, they're simply not aligned with the new usage models enabled by the cloud. Continual optimization is a critical third piece of your migration journey. Optimization targets two main areas—ensuring peak performance and driving continual cost efficiency.

Ensure continual cost efficiency and optimization

Performance monitoring can help you achieve cost optimization. During the Assess step, you performed rightsizing for on-premises workloads based on a point in time. Once those workloads are moved to Azure, their usage could change. For example, if you move a moderately used app from on-premises to Azure, initially a middle-tier VM and D2 v3 instance (2 vCPU and 8 GB RAM) might be recommended. However, after six months, if the use of that application has declined, you'd want to downsize to a lower VM instance to reduce costs.

Azure Cost Management shows you usage and costs so you can track trends, detect inefficiencies, and create alerts. All usage statistics and cost data are displayed in intuitive dashboards and reports. With Azure built-in cost management services, you can continually monitor for CPU and memory usage. This enables recommendations for VM instances that can be further rightsized. These services can help you detect over-utilized VMs and upsize, as needed, to ensure performance SLAs.

These services can also help you discover underutilized VMs for potential downsizing. For example, Azure cost optimization can provide a regular view of your current total VM utilization. At a glance, you can determine the number of VMs that are consistently underutilized (that is, running below 90 percent). Then, with Azure cost

optimization sizing, you can find recommendations for which VMs should be resized, as well as the suggested instance change (including potential annual savings).

As you continue to use your new IaaS environment, targeting maximum cost savings through Azure Reserved VM Instances becomes attractive. Reporting available in Azure Cost Management can point out the workloads that would benefit from Reserved VM Instances, maximizing your TCO.

Drive application innovation

While you're migrating existing VMs to Azure, it's also the perfect time to look toward application modernization. This allows you to take advantage of your cloud provider to deliver additional cost savings and flexibility.

Cloud optimization is the next logical strategy after lift and shift (or rehosting) for your workloads because many of them will be able to take advantage of other cloud migration strategies. The PaaS services of immediate interest are containers, app services, and database services. Why look at cloud optimization so soon after migrating? The answer is simple. Now that you've done all the hard work of assessing your workloads, analyzing them, and migrating them to the cloud, you've made it easier to take the step to PaaS. Plus, you can get more cost benefits through reduced management and operating expenses.

A clear place to start is containerization. Containerization is an OS-level virtualization method used to deploy and run distributed applications without launching an entire VM for each app. With containerization, you get immediate savings on operational expenses because of a reduced footprint in the cloud. Remember that the smaller your footprint, the more economical it is. Containerization rapidly moves compatible apps to containers (and out of large VMs) with no code changes. It immediately provides the benefit of running multiple apps with no affect on the end user experience.

The next consideration in optimization is moving to specific PaaS services. There are many options to choose from, but App Service and Azure SQL Database are good ones to start with because of the ease of the migration activity. In many cases, web and mobile applications can migrate to App Service with little refactoring effort.

By moving from rehost to other cloud migration strategies, you can significantly lower TCO by reducing your footprint and management needs.
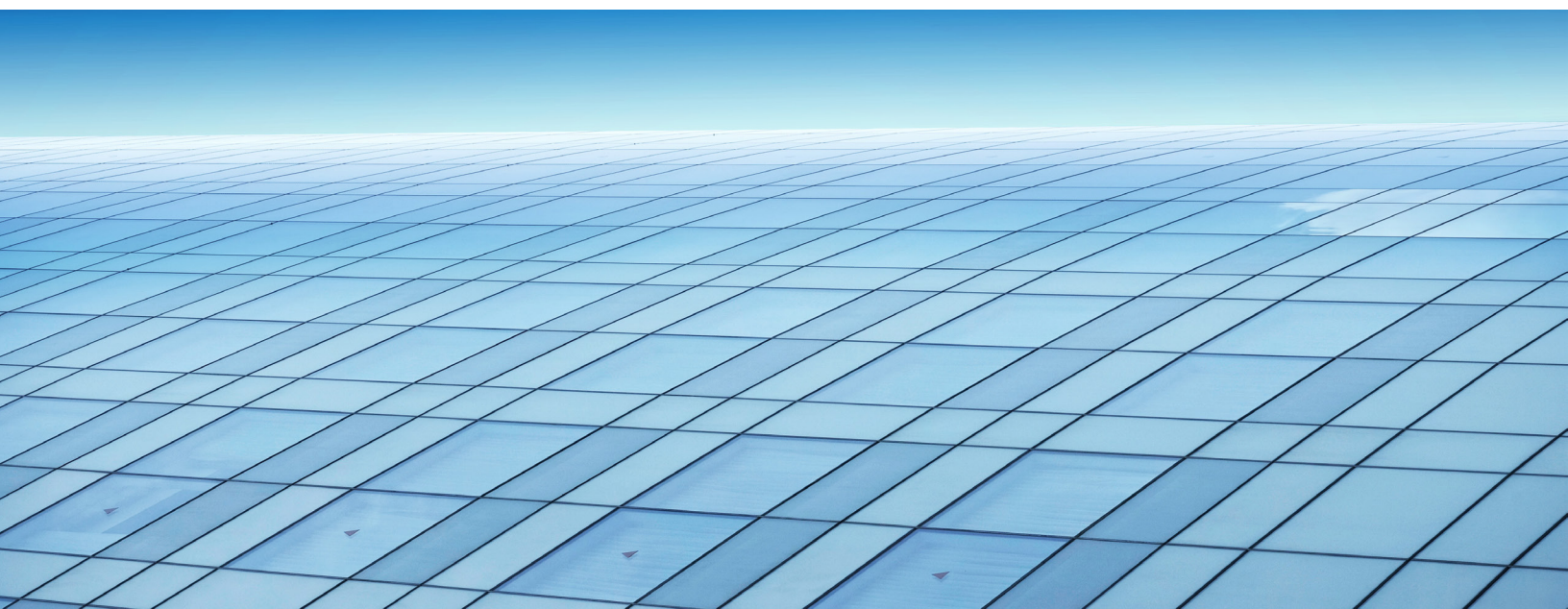
It's important to note that there will be an initial investment of time, effort, and budget to move to more advanced PaaS services. In some cases, if the application is cloud ready, the migration will be simple, but in others, configuration changes and code updates might be required. Fortunately, there are tools available that enable you to analyze your code and determine the effort required to move to app services.

For your databases, the process is straightforward. Azure provides options for database PaaS services, including Azure SQL Database, where you host the data on a full DBaaS platform. Azure SQL Database enables you to host database data in a service, reducing your database management costs, but it has some limitations compared to a full SQL Server deployment. If your applications need functionality that might not be available in Azure SQL Database, Azure SQL Database Managed Instance is the recommend choice. Azure SQL Database Managed Instance enables the full platform experience of SQL Server; however, the underlying OS and SQL services are fully managed by Azure.

Tools for optimization

For more information about optimization tools, explore these resources:

Azure Cost Management. Get detailed visibility into the resource costs of running systems on Azure. Learn more about Azure Cost Management.

Secure and manage

Once you've migrated, you'll want to keep your VMs continuously secure, protect your data, and monitor your cloud health. All that's easy to do with Azure—once you have an understanding of the full suite of available controls and capabilities.

Secure cloud resources

Ensuring strong security for your cloud-based resources is a responsibility that's shared between you and your cloud provider. Azure is built with a foundation of trust and security, compliance, privacy, and transparency. The Azure platform provides a solid foundation on which to host your infrastructure, with built-in security controls and capabilities to help further protect your data and applications.

Azure Security Center provides unified security management and advanced threat protection across hybrid cloud workloads. Azure Security Center enables you to take advantage of capabilities like these:

Centralized policy management. Ensure compliance with company or regulatory security requirements by centrally managing security policies across all your hybrid cloud workloads.

Continuous security assessment. Monitor the security of machines, networks, storage and data services, and applications to discover potential security issues.

Actionable recommendations. Remediate security vulnerabilities—before they can be exploited by attackers—with prioritized and actionable security recommendations.

Advanced cloud defenses. Reduce threats with just-in-time access to management ports and whitelisting to control applications running on your VMs.

Prioritized alerts and incidents. Focus on the most critical threats first by taking advantage of prioritized security alerts and incidents.

Integrated security solutions. Collect, search, and analyze security data from a variety of sources, including connected partner solutions.

Protect data

Azure helps ensure workloads and data are fully backed up and protected from disasters while providing encryption of stored data for internal and customer security. Azure can also automatically encrypt your stored data—while allowing full accessibility to all applications and users.

VM disk encryption. Azure Disk Encryption enables encryption of Windows and Linux Azure Virtual Machines disks. Azure Disk Encryption uses the industry-standard BitLocker feature of Windows and the dm-crypt feature of Linux to provide volume encryption for the OS and data disks. The solution is integrated with Azure Key Vault to help you control and manage the disk encryption keys and secrets in your key vault subscription while ensuring that all data in the VM disks is encrypted at rest in your Azure storage.

VM backup. Azure Backup is a scalable solution that protects your application data with zero capital investment and minimal operating costs. Application errors can corrupt your data, and human errors can introduce bugs into your applications. With Azure Backup, your VMs running Windows and Linux are protected.

Azure Site Recovery. An important part of your organization's business continuity and disaster recovery (BCDR) strategy is figuring out how to keep corporate workloads and apps up and running when planned and unplanned outages occur. Azure Site Recovery helps orchestrate the replication, failover, and recovery of workloads and apps so that they're available from a secondary location if your primary location goes down.

Monitor cloud health

As with any system, monitoring cloud health is important to drive both proactive and reactive analysis. Azure provides many monitoring services targeted at applications, workloads, and core service health to ensure you have full visibility into current system status—and access to important data when you're working with a break-fix situation.

Azure Monitor. Azure Monitor enables you to monitor Azure services by collecting metrics, activity logs, and diagnostic logs. For example, the activity log tells you when new resources are created or modified. Metrics are available that provide performance statistics for various resources—and even for the OS inside a VM. You can view this data with one of the explorers in the Azure portal, send it to Azure Log Analytics for trending and detailed analysis, or create alert rules to notify you of critical issues proactively. Standard metrics are free and include select metrics originating from Azure resources, services, and first-party solutions. More advanced metrics—including insights into the availability, performance, and usage of your applications, along with health monitoring and alert rules—are also available. For more information, see Azure Monitor pricing.

Service Map. Service Map provides insight into your IaaS environment by analyzing VMs and their dependencies on other computers and external processes. It integrates events, performance data, and management solutions in Log Analytics. You can view this data in the context of each computer and its relation to the rest of your environment.

Network Watcher. Network Watcher provides scenario-based monitoring and diagnostics for various network scenarios in Azure. It stores data in Azure metrics and diagnostics for further analysis.

Service Health. It's important to be aware of any issues with the Azure services your applications depend on. Azure Service Health identifies issues with Azure services and helps you plan for scheduled maintenance.

Azure Advisor. Azure Advisor constantly monitors your resource configuration and usage telemetry. It then gives you personalized recommendations based on best practices. Following these recommendations can help you improve the performance, security, and availability of the resources that support your applications.

Many premium management solutions are packaged sets of logic that provide insights for an application or service.

They rely on log analytics to store and analyze the monitoring data that they collect. Azure Log Analytics enables deeper visibility into your hybrid IT environment and allows you to diagnose performance issues from an advanced analytics portal with one click. With Azure Log Analytics, you can:

Analyze data. You can use provided dashboards to run log searches by constructing queries to analyze collected data. These dashboards can be customized with graphical views of your most valuable searches. Once you have a defined collection of operational data from your Azure VMs and activity logs, you can perform powerful searches.

Visualize data. Log Analytics dashboards can visualize all your saved log searches, giving you the ability to find, correlate, and share IT operational data.

Get data alerts. Alerts in Microsoft Azure inform you about important information in your repository. They are created by alert rules that automatically run log searches at regular intervals and match certain criteria. With Action groups, you can perform advanced actions with alerts, such as creating an email notification, launching an automation runbook, or creating an incident record in your ITSM incident management system.

Tools for security and management

For more information about security and management tools, explore these resources:

Azure Security Center. Apply security policies across workloads, limit exposure to threats, and detect and respond to attacks. Learn more about Azure Security Center.

Azure Log Analytics. Centralize log data from multiple systems in a single data store. Learn more about Azure Log Analytics.

Azure Monitor. Get detailed, up-to-date performance and utilization data; access to an activity log that tracks every API call; and diagnostic logs that help you debug issues in your Azure resources. Learn more about Azure Monitor.

Summary

The key to a successful cloud migration is breaking the process into steps—regardless of why your organization wants to move or how complex your current environment is.

You can use the information outlined in this e-book to start with a few applications, and then continue to expand to more of your environment.

First, you need a clear plan that takes into careful consideration your servers, VMs, and workloads—and what's required for these to function in the cloud. Along with this assessment, you need to determine your true usage of resources and analyze any configuration dependencies for your workloads. Then, as you move forward with migration, you need to make sure that your workloads in the cloud are in sync with your on-premises system in real time. Along with this, you'll want to test the health of your system so that your final cutover is smooth. Finally, you should continue your cloud journey by pursuing even greater cost efficiency through optimization and by keeping your workloads operating securely at peak performance.

The benefits of migration can be immediate in terms of time and budget. The cloud can help you be more agile and, in many cases, help you respond to business needs faster. The cloud can help you in reducing your TCO, freeing you to take that massive savings and invest it back into your business to drive faster modernization. Plus, you can explore PaaS and SaaS options, decreasing your TCO even more while expanding your IT capability.

Pay less with Azure

AWS is 5 times more expensive than Azure for Windows Server and SQL Server.

For more information, see Azure vs. AWS Cost Comparison.

Whether you're in the early stages of assessment or planning your approach, keep in mind that migration is easier with a trusted provider like Microsoft. Through integrated tools, a strong partner ecosystem, and rich guidance, you can tread a well-forged path to minimize risk and possible negative impact to your business.

For access to expert guidance and resources designed to ease your cloud migration, sign up for the Azure Migration Program.

Additional resources

Get Pluralsight training

Assessing and Planning Microsoft Azure Migration

Microsoft Azure Architecture—Getting Started

Designing Migrations for Microsoft Azure

Compare costs

Estimate the cost savings you can realize by migrating your workloads to Azure. Check out the Total Cost of Ownership (TCO) Calculator.

Pay less with Azure. Learn about how AWS is five times more expensive than Azure for Windows Server and SQL Server.