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Case Study on Microsoft Azure in Cloud

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I. INTRODUCTION

Microsoft Azure, launched in 2010, is a widely used cloud computing platform that simplifies building, deploying, and managing applications.

It gives services like compute, storage, networking, analytics, databases, cognitive services, and Internet of Things. With a “Pay-As-You-Go” pricing model, Azure provides scalable virtual resources without heavy upfront infrastructure costs.

- Microsoft’s cloud platform, similar to AWS and Google Cloud.
- Provides virtual machines, analytics, monitoring tools, and fast data processing.
- Eliminates the need for large physical infrastructure and investment.
- Cost-effective model where users pay only for the resources they consume.

II. WORKING OF MICROSOFT AZURE

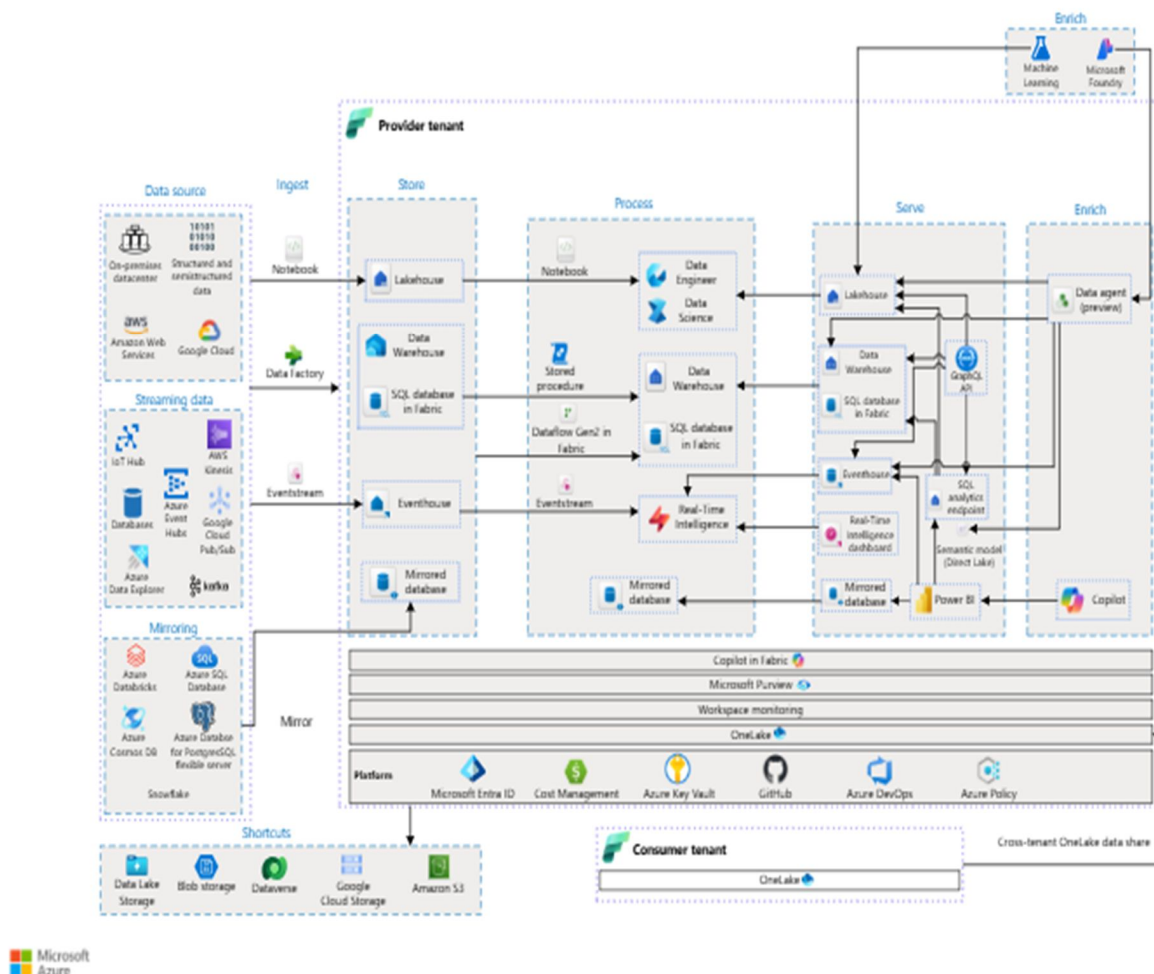
Microsoft Azure is a public and private cloud platform that enables developers and IT professionals to build, deploy, and manage applications. It relies on virtualization, where a hypervisor abstracts hardware to run multiple virtual machines with different operating systems.

- Uses hypervisors to run multiple virtual machines on a single physical server.
- Supports operating systems like Windows and Linux within virtual environments.
- Operates massive data centres with interconnected servers to ensure scalability and performance.

III. MICROSOFT AZURE ARCHITECTURE

Microsoft Azure is a global cloud platform that enables users to build, deploy, and manage applications and services across scalable infrastructure. Azure relies on virtualization and software-defined networking (SDN) to optimize resource usage and performance. Its architecture evolves continuously to meet growing demands, emphasizing effective design, scalability, and resource management.

- Provides tools for application development, hosting, data storage, IoT, and machine learning.
- Supports diverse languages such as JavaScript, Python, and PHP, HTML5, and C #.
- Uses global data centres, virtualization, and SDN for scalability and efficient infrastructure.
- Enables secure online storage for various data types with remote accessibility.
- Encourages use of reference architectures, design principles, and cloud design patterns for reliable, scalable systems.



Azure Architecture

IV. THE 3 SERVICE CATEGORIES PROVIDED BY MICROSOFT AZURE

Microsoft Azure is a cloud computing platform that offers the following three categories of services:

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)

A. Infrastructure as a service (IaaS)

Virtual machines, storage, and networking will come under the category of infrastructure as a service but the users have to do manually the build and deploy of the applications. Azure will support a wide range of operating systems because of its Hyper-hypervisor.

B. Platform as a service (PaaS)

Azure app service, [Azure functions](#), and logic apps are some services that are offered by Azure under the platform as a service. This service will provide autoscaling and [load balancing](#) and also there will be a pre-configured environment for the application.

C. Software as a service (SaaS)

Office 365, Dynamics 365, and [Azure Active Directory](#) are some of the services provided by Microsoft Azure under [Software as a Service \(SaaS\)](#) the complete application will be managed by the Microsoft azure including [deploying](#), [scaling](#) and [load balancing](#).

V. MICROSOFT AZURE USE CASES

Following are the some the use cases that Microsoft Azure Used.

- 1) Deployment Of applications: You can develop and deploy the application in the azure cloud by using the service called Azure App Service and Azure Functions after deploying the applications end users can access it.
- 2) Identity and Access Management: The application and data which is deployed and stored in the Microsoft Azure can be secured with the help of Identity and Access Management. It's commonly used for single sign-on, multi-factor authentication, and identity governance.
- 3) Data Storage and Databases: You can store the data in Microsoft azure in service like blob storage for unstructured data, table storage for NoSQL data, file storage, and Azure SQL Database for relational databases. The service can be scaled depending on the amount of data we are getting.
- 4) DevOps and Continuous Integration/Continuous Deployment (CI/CD): Azure DevOps will provide some tools like including version control, build automation, release management, and application monitoring.

VI. VARIOUS AZURE SERVICES

Following are some of the services Microsoft Azure offers:

- Compute: Includes Virtual Machines, Virtual Machine Scale Sets, Functions for server less computing, Batch for containerized batch workloads, Service Fabric for micro services and container orchestration, and Cloud Services for building cloud-based apps and APIs.
- Networking: With Azure, you can use a variety of networking tools, like the Virtual Network, which can connect to on-premise data centres; Load Balancer; Application Gateway; VPN Gateway; Azure DNS for domain hosting, Content Delivery Network, Traffic Manager, Express Route dedicated private network fibre connections; and Network Watcher monitoring and diagnostics
- Storage: Includes Blob, Queue, File, and Disk Storage, as well as a Data Lake Store, Backup, and Site Recovery, among others.
- Web + Mobile: Creating Web + Mobile applications is very easy as it includes several services for building and deploying applications.
- Containers: Azure has a property that includes Container Service, which supports Kubernetes, DC/OS or Docker Swarm, and Container Registry, as well as tools for micro services.
- Databases: Azure also included several SQL-based databases and related tools.
- Data + Analytics: Azure has some big data tools like HDInsight for Hadoop Spark, R Server, HBase, and Storm clusters
- AI + Cognitive Services: With Azure developing applications with artificial intelligence capabilities, like the Computer Vision API, Face API, Bing Web Search, Video Indexer, and Language Understanding Intelligent.
- Internet of Things: Includes IoT Hub and IoT Edge services that can be combined with a variety of machine learning, analytics, and communications services.
- Security + Identity: Includes Security Center, Azure Active Directory, Key Vault, and Multi-Factor Authentication Services.
- Developer Tools: Includes cloud development services like Visual Studio Team Services, Azure DevTest Labs, HockeyApp mobile app deployment and monitoring, Xamarin cross-platform mobile development, and more.

VII. AZURE FOR DISASTER RECOVERY AND BACKUP

A full range of disaster recovery (DR) and backup services are available from Microsoft Azure to help shield your vital data and apps from interruptions. With the help of these services, you may quickly restore your data and applications in the event of a disaster by replicating them to a secondary cloud site. Azure backup services also protect your data from ransomware attacks, unintentional deletion, and corruption.

A. Key Azure DR and Backup Services

- Azure Site Recovery: Your on-premises virtual machines (VMs) can be replicated to Azure more easily with the help of this solution. You may easily failover your virtual machines (VMs) to Azure in the event of a disaster and keep your business running. Azure VM replication to an alternative Azure region is also supported by Azure Site Recovery.
- Azure Backup: If you want to protect the data which is present in the cloud then you need to use the Azure Backup service. It offers a single area to monitor backup jobs, manage backup policies, and recover data. Azure pricing and costs.

B. Azure Competition

Following are the some of the competitors of Microsoft Azure:

- Amazon Web Services (AWS): Market leader offering a wide range of cloud services with extensive global infrastructure.
- Google Cloud Platform (GCP): It known for its innovative services like Big Query and Tensor Flow, with a strong focus on data analytics and machine learning.
- IBM Cloud: It offers a comprehensive suite of cloud services, including AI, block chain, and IoT solutions, with a focus on enterprise clients.
- Oracle Cloud Infrastructure (OCI): IT focuses on enterprise-grade cloud solutions, including databases, applications, and infrastructure services, leveraging Oracle's expertise in enterprise software.

C. Azure Use-cases that helps in Business

Azure can help our business in the following ways:

- Capital less: We don't have to worry about the capital as Azure cuts out the high cost of hardware. You simply pay as you go and enjoy a subscription-based model that's kind to your cash flow. Also, setting up an Azure account is very easy. You simply register in Azure Portal and select your required subscription and get going.
- Less Operational Cost: Azure has a low operational cost because it runs on its servers whose only job is to make the cloud functional and bug-free, it's usually a whole lot more reliable than your own, on-location server.
- Cost Effective: If we set up a server on our own, we need to hire a tech support team to monitor them and make sure things are working fine. Also, there might be a situation where the tech support team is taking too much time to solve the issue incurred in the server. So, in this regard is way too pocket-friendly.
- Easy Back-Up and Recovery options: Azure keeps backups of all your valuable data. In disaster situations, you can recover all your data in a single click without your business getting affected. Cloud-based backup and recovery solutions save time, avoid large up-front investments and roll up third-party expertise as part of the deal.
- Easy to implement: It is very easy to implement your business models in Azure. With a couple of on-click activities, you are good to go. Even there are several tutorials to make you learn and deploy faster.
- Better Security: Azure provides more security than local servers. Be carefree about your critical data and business applications. As it stays safe in the Azure Cloud. Even, in natural disasters, where the resources can be harmed, Azure is a rescue. The cloud is always on.
- Work from anywhere: Azure gives you the freedom to work from anywhere and everywhere. It just requires a network connection and credentials. And with most serious Azure cloud services offering mobile apps, you're not restricted to which device you've got to hand.
- Increased collaboration: With Azure, teams can access, edit and share documents anytime, from anywhere. They can work and achieve future goals hand in hand. Another advantage of Azure is that it preserves records of activity and data. Timestamps are one example of Azure's record-keeping. Timestamps improve team collaboration by establishing transparency and increasing accountability.

VIII. AZURE CLOUD SHELL

Azure PowerShell is an extension of Windows PowerShell that allows users to manage Azure's vast features through the PowerShell interface. Developers use cmdlets—pre-written scripts—to perform complex tasks like deploying virtual machines (VMs) or creating cloud services from the command line. Azure PowerShell (APS) can also automate processes through scripting.

With Azure Cloud Shell, you can:

- Execute commands and scripts on your Azure resources using a unified command-line interface that offers features like tab completion and command history.
- Manage your Azure subscription with a comprehensive set of commands that allow you to create, list, and delete subscriptions, as well as control user access keys.
- Begin interactive tutorials to learn how to use common features, such as creating virtual machines or virtual networks.

A. How to Access Azure Shell?

Azure Cloud Shell provides a convenient way to manage and develop Azure resources directly from your browser. You can access it through the Azure portal at <https://portal.azure.com> by clicking the **Cloud Shell** icon in the top navigation bar. It offers both **Bash** and **PowerShell** environments, allowing you to run command-line tasks without installing any tools locally. To know about How to access Azure Shell you can refer to this link [How to access Azure Shell?](#)

B. Azure Security

Azure Security encompasses the various tools and features provided by Microsoft on its Azure cloud platform to ensure security. According to Microsoft, these tools include a comprehensive range of physical, infrastructure, and operational controls designed to protect its cloud services.

As a public cloud computing platform, Azure supports a diverse array of programming languages, operating systems, frameworks, and devices. Users can access Azure's services and resources from anywhere as long as they have an internet connection.

C. Microsoft Defender for Cloud

Microsoft Defender for Cloud is a comprehensive security management platform provided by Microsoft for Azure users. It offers several key benefits, including:

- **Visibility and Control:** It enables users to gain insight and manage the security of various Azure resources, such as Virtual Machines, Cloud Services, Azure Virtual Networks, and Blob Storage.
- **Protection for Hybrid Workloads:** It secures workloads that are deployed both within Azure and in non-Azure environments, including on-premises systems.
- **Enhanced Security Posture:** The Azure Security Centre continuously monitors the cloud environment, helping users understand the security status of their resources and improve their security posture.
- **Threat Detection and Mitigation:** With a centralized dashboard, the Azure Security Centre provides alerts and recommendations, assisting organizations in detecting and preventing cyber security threats. This also aids in regulatory compliance by streamlining security policies across the platform.

Additionally, Microsoft Defender for Cloud tackles several security challenges:

- **Dynamic Workloads:** As customers utilize a variety of cloud services that frequently change, the Azure Security Centre simplifies the implementation of security standards and best practices.
- **Evolving Threats:** With more organizations shifting to the public cloud, cyber threats have become increasingly sophisticated. Azure Security Centre helps customers secure their workloads and minimizes vulnerabilities by promoting adherence to security best practices.
- **Lack of Security Expertise:** The high volume of security alerts can overwhelm administrators, especially those with limited experience. Azure Security Centre equips administrators with tools to effectively respond to and manage these threats.

D. Microsoft Defender for Cloud Working

According to Azure Security documentation, Microsoft Azure employs a shared security responsibility model, indicating that security is a collaborative effort between Azure and its customers. In on-premises environments, the entire security burden lies with the customer. However, as customers transition to the cloud, certain security responsibilities shift to Azure.

Here's how the responsibilities vary across different cloud service models:

- **Infrastructure as a Service (IaaS):** Azure assumes responsibility for physical security, including hosts, networks, and data centers.
- **Platform as a Service (PaaS):** Azure manages physical security and the operating system, while responsibilities for identity and directory infrastructure, network controls, and applications are shared with customers.
- **Software as a Service (SaaS):** Azure takes on even more responsibilities, including physical security, operating systems, network controls, and applications, while still sharing identity and directory infrastructure with the customer.

E. Azure Security Best Practices

The Azure Security documentation serves as a valuable resource for security recommendations and best practices. Here are some key tips to help you enhance your security posture:

- **Implement Role-Based Access Control (RBAC):** Use Azure Security Center's RBAC to manage permissions effectively. Familiarize yourself with the five built-in roles (Subscription Owner, Resource Group Owner, Subscription Contributor, Resource Group Contributor, and Reader) and two specific security roles (Security Administrator and Security Reader), each with different levels of access.
- **Regularly Monitor the Azure Security Center Dashboard:** Keep an eye on the dashboard for a centralized view of your Azure resources, which also provides actionable recommendations.
- **Establish Security Policies:** Implement security policies to prevent misuse of resources. Azure can automatically generate a security policy tailored to your subscription.
- **Upgrade to Azure Security Center Standard:** By upgrading your subscription, you can access advanced features such as identifying and resolving security vulnerabilities, leveraging analytics for threat detection, and enabling quick responses to security incidents.
- **Utilize Azure Key Vault:** Store your keys securely in Azure Key Vault, which is specifically designed to manage secrets like passwords and database credentials.
- **Implement a Web Application Firewall:** Protect your applications from common threats and vulnerabilities by installing a web application firewall.
- **Enable Azure Multi-Factor Authentication (MFA):** Use MFA, particularly for administrative accounts, to add an extra layer of security.
- **Encrypt Virtual Hard Disks:** Ensure the confidentiality of your data by encrypting virtual hard disk files.
- **Connect Azure Virtual Machines via Virtual Networks:** Enhance security by placing Azure VMs on virtual networks when connecting to other networked devices.
- **Leverage Azure DDoS Protection:** Utilize Azure's Distributed Denial of Service (DDoS) services to safeguard against and mitigate DDoS attacks.

F. Features of Azure

Azure offers a comprehensive array of features designed to enhance data protection and application management:

- **Data Protection:** Azure ensures the security of your data through various methods, including replication, snapshots, and encryption. These options allow for data protection across multiple regions globally, providing an added layer of security against natural disasters, cyberattacks, or hardware failures. By storing data in various data centers worldwide, Azure guarantees that your information remains safe, even if one location experiences an incident.
- **Azure Site Recovery:** This feature gives you full control over data replication processes, allowing you to define the level of detail and metrics to monitor. You can customize the replication schedule based on your business requirements, ensuring your data remains secure and accessible.
- **Development Flexibility:** Azure supports a wide range of capabilities for building, deploying, and managing applications that can run on any device at any time. Users can choose their preferred programming languages and frameworks, enabling horizontal scaling by adding servers or distributing the load across multiple servers.
- **App Services and Mobile Management:** Azure offers hosting through App Services, allowing you to quickly deploy updates and new features to your applications without downtime. It also supports mobile device management (MDM) for apps tailored to mobile users.
- **Active Directory Integration:** Azure Active Directory (AAD) enhances security by connecting user profiles with applications, enabling seamless sign-in experiences. Through Active Directory synchronization, user accounts, groups, and permissions are automatically managed between on-premises Active Directory and Azure Active Directory, streamlining user management and policy enforcement within your organization.

By leveraging these features, Azure enables businesses to build resilient, scalable, and secure applications tailored to their needs.

IX. DIFFERENCE BETWEEN AWS, GOOGLE CLOUD, AND AZURE

The following are the differences among AWS, Google Cloud and Azure:

Feature	AWS	Google Cloud	Azure
Technology	<u>EC2 (Elastic Compute Cloud)</u>	<u>Google Compute Engine (GCE)</u>	VHD (Virtual Hard Disk)
Databases Supported	Fully supports relational and NoSQL databases and Big Data	Fully supports technologies like <u>Big Query</u> , Big Table, Hadoop	Supports relational and NoSQL through Windows Azure Table and HDInsight
Pricing	Per hour — rounded up	Per minute — rounded up	Per minute — rounded up
Models	On-demand, reserved spot	On-demand sustained use	Per minute rounded up commitments (Pre-paid or monthly)
Difficulties	Many enterprises find it difficult to understand the cost structure	Fewer features and services	Less "Enterprise-ready"
Storage Services	Simple Storage Service (S3), Elastic Block Storage, Elastic File Storage	<u>Blob Storage</u> , Queue Storage, File Storage, Disk Storage, Data Lake Store	Cloud Storage, Persistent Disk, Transfer Appliance
Machine Learning	SageMaker, Lex, Polly, and many more	Cloud Speech AI, Cloud Video Intelligence, Cloud ML Engine	Azure Bot Service, Cognitive Service

A. Scaling and Management of Azure

The following services are used in scaling and in management in Azure Cloud:

- Auto-scaling: Azure provides auto-scaling capabilities, allowing resources to automatically scale up or down based on demand, ensuring optimal performance and cost-efficiency.
- Resource Groups: Resources in Azure can be organized into resource groups, simplifying management and enabling centralized monitoring and control.
- Azure Resource Manager: It facilitates resource deployment, management, and monitoring through templates, providing a unified management interface.

B. Azure Monitoring Services

The following are the some of the Azure Monitoring Services:

- Azure Monitor: Centralized monitoring service for Azure resources, offering insights into performance, availability, and usage metrics.
- Application Insights: Provides real-time insights into application performance and usage, enabling proactive troubleshooting and optimization.
- Log Analytics: Collects and analyzes log data from various sources, offering valuable insights for troubleshooting, security monitoring, and compliance.
- Azure Advisor: Offers personalized recommendations for optimizing Azure resources, enhancing performance, and reducing costs.

C. Pricing in Microsoft Azure

Pricing Option	Description	Billing	Ideal For	Savings/Notes
Pay-As-You-Go	Pay only for what you use, with no long-term commitment.	Per minute or per second (depending on service).	Startups, small businesses, unpredictable workloads.	Flexible, easy to scale up/down.
Reserved Instances	Commit to 1- or 3-year terms for specific resources to get discounts.	Upfront or monthly payments.	Predictable workloads, long-term projects.	Save up to 72% compared to Pay-As-You-Go.
Spot Instances	Buy unused Azure capacity at a deep discount.	Per second billing.	Batch jobs, dev/test environments, workloads tolerant to interruptions.	Up to 90% savings, but instances can be evicted when capacity is needed.
Azure Hybrid Benefit	Use existing Windows Server or SQL Server licenses to save costs.	Discounted rates applied automatically.	Businesses already using Windows Server and SQL Server on-premises.	Significant savings on Windows/Linux VMs and SQL Server workloads.
Dev/Test Pricing	Discounted rates for development and testing environments.	Discounted Pay-As-You-Go billing.	Developers and testers in non-production environments.	Available through Dev/Test subscriptions in Azure.

D. Cost Management Tools in Azure

Tool	Purpose
Azure Cost Management and Billing	Helps monitor, analyze, and control Azure spending with detailed reports and budget alerts.
Azure Pricing Calculator	Estimates the cost of Azure services based on your configuration and usage assumptions.
Azure Advisor	Provides personalized best-practice recommendations for cost optimization, security, reliability, and performance improvements.

X. CONCLUSION

In conclusion, Microsoft Azure has emerged as one of the most powerful and versatile cloud computing platforms, offering a wide range of services that support modern application development, deployment, storage, security, and business continuity. Through its service models—Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)—Azure provides flexible solutions that meet the diverse needs of organizations, from startups to large enterprises.

This case study highlights how Azure simplifies IT infrastructure management through virtualization, scalable resources, integrated security, disaster recovery solutions, and cost-effective pricing models. Its rich ecosystem of services in compute, networking, analytics, AI, IoT, and monitoring enables businesses to innovate rapidly while maintaining operational efficiency and reliability. Furthermore, Azure's strong focus on security, scalability, availability, and cost optimization makes it a competitive choice among major cloud providers like Amazon Web Services and Google Cloud. Features such as Azure Security Centre, Azure Backup, Azure Monitor, and Azure Resource Manager enhance both governance and resilience, helping organizations manage workloads effectively in dynamic environments.

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