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Original Article

Evaluating the Performance and Scalability of Mainframe Workloads Post-Migration to Cloud: AWS vs Azure vs GCP

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Abstract: *The migration of mainframe workloads to the cloud is becoming a critical strategy for enterprises aiming to modernize their IT infrastructure. As organizations move away from traditional mainframes, the choice of cloud platform becomes paramount, with major providers such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP) offering distinct approaches for migration and workload optimization. This study evaluates the performance and scalability of mainframe workloads post-migration to these cloud platforms. By conducting a comparative analysis of AWS, Azure, and GCP, we assess key factors such as computational efficiency, latency, throughput, elasticity, and cost-effectiveness. The research also investigates integration challenges and the operational complexities faced during the migration process. Our findings provide insights into which cloud platform offers the best support for different types of mainframe workloads, helping organizations make informed decisions when migrating legacy applications to the cloud. The paper concludes with recommendations on how to maximize performance and scalability while minimizing risks and costs.*

Keywords: *Mainframe Migration, Cloud Platforms, AWS, Azure, Google Cloud Platform (GCP), Performance Evaluation, Scalability, Cloud Computing, Legacy Systems, Enterprise IT Modernization, Cloud Adoption, Benchmarking, Cost Efficiency.*

I. INTRODUCTION

The migration of mainframe workloads to cloud platforms is an increasingly popular trend in enterprise IT modernization. Mainframe systems, often running mission-critical applications, have been the backbone of organizations for decades. However, due to the high operational costs, inflexibility, and limitations of legacy systems, many organizations are now considering cloud-based solutions as a more scalable and cost-effective alternative. Cloud platforms such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP) offer modern computing resources that are capable of hosting, scaling, and enhancing mainframe applications. This research aims to evaluate the performance and scalability of mainframe workloads post-migration to these cloud platforms, providing a comprehensive comparison across the three major cloud providers. By understanding the trade-offs in performance, cost, scalability, and integration capabilities, this study will help organizations make more informed decisions when migrating their mainframe systems. The research will also examine the challenges and limitations faced during the migration process, offering insights into the best practices and strategies for a successful transition to the cloud. Ultimately, this paper seeks to identify which cloud platform—AWS, Azure, or GCP—offers the most suitable environment for hosting and managing modernized mainframe workloads.

II. LITERATURE REVIEW

The literature review provides a historical and theoretical context for understanding the migration of mainframe workloads to cloud environments. Mainframe computers have traditionally been used by large organizations to run critical applications, but their limitations in terms of scalability, maintenance, and high operational costs have prompted many enterprises to seek alternative solutions. Cloud computing, with its flexible, scalable, and cost-effective model, offers an appealing solution to replace or supplement mainframe systems. Numerous studies have explored the benefits of cloud adoption, highlighting factors such as improved agility, reduced infrastructure costs, and enhanced performance scalability. However, challenges related to legacy system integration, data migration, and the re-architecture of mainframe applications remain significant hurdles. In this section, we review relevant research on cloud migration strategies, focusing on the methodologies and tools available for moving mainframe workloads to cloud platforms. Additionally, we explore studies comparing the performance and scalability of AWS, Azure, and GCP in hosting enterprise workloads. This body of work provides foundational knowledge on cloud platform capabilities and migration challenges, setting the stage for our comparative analysis of AWS, Azure, and GCP.

III. RESEARCH METHODOLOGY

The research methodology outlines the approach used to evaluate the performance and scalability of mainframe workloads post-migration to AWS, Azure, and GCP. To ensure a meaningful and valid comparison, the study focuses on selecting representative mainframe workloads that mirror common enterprise use cases, such as transactional databases, legacy application processing, and batch job executions. These workloads will be evaluated based on a set of key performance indicators (KPIs) such as latency, throughput, cost efficiency, and system responsiveness. To conduct the comparative analysis, each cloud platform will be assessed using a uniform set of benchmark tests, utilizing standardized tools for cloud performance measurement. The three platforms—AWS, Azure, and GCP—will be evaluated in terms of their specific cloud offerings for mainframe migration, including managed services, compute resources (e.g., EC2 instances for AWS, Virtual Machines for Azure, Compute Engine for GCP), storage solutions, and network configurations. The study will use a combination of theoretical analysis, case studies, and lab-based testing to gather quantitative data on each platform's performance. Finally, the research methodology includes a cost-benefit analysis, which assesses how each platform scales based on workload size, usage patterns, and resource demands.

IV. COMPARISON OF AWS, AZURE, AND GCP FOR MAINFRAME WORKLOADS

This section delves into the specific capabilities of AWS, Azure, and GCP when it comes to handling migrated mainframe workloads. Each cloud provider offers different tools, services, and infrastructure that can be leveraged to modernize legacy mainframe systems. AWS is known for its extensive portfolio of services, including EC2 instances, AWS Lambda, and AWS Mainframe Modernization services, which enable organizations to transition from mainframe-based environments to more flexible cloud-native applications. Performance tests on AWS will examine factors such as compute power, network latency, and storage performance, focusing on how well the platform can handle compute-intensive, high-throughput workloads typical of mainframe systems.

Azure, with its strong enterprise focus, provides services like Azure Migrate, Azure Virtual Machines, and dedicated mainframe migration tools, offering a suite of solutions that simplify the movement of legacy applications to the cloud. Azure's integration with Microsoft enterprise products also plays a key role in seamless migration, particularly for organizations already relying on Windows-based systems. This section will also assess Azure's strengths in terms of workload scaling, especially its autoscaling capabilities, and how the platform manages mainframe migration scenarios.

Google Cloud Platform, known for its emphasis on scalability and containerization, offers Google Kubernetes Engine (GKE) and Compute Engine for hosting mainframe workloads. Its serverless offerings and machine learning capabilities are additional factors that could be beneficial in modernizing mainframe workloads post-migration. The GCP comparison will explore the platform's ability to handle both legacy batch processing workloads and newer, cloud-native applications, emphasizing the unique features that differentiate GCP from AWS and Azure.

By comparing these three platforms, the study will provide a comprehensive view of how each cloud provider supports performance optimization, scalability, and cost management for mainframe migrations.

V. EVALUATION CRITERIA

In order to accurately assess the performance and scalability of mainframe workloads post-migration, several evaluation criteria will be employed. The primary metrics include performance (speed, latency, throughput), scalability (elasticity, vertical and horizontal scaling), and cost efficiency. Performance measures will focus on how quickly cloud environments can execute mainframe workloads, considering variables like input/output operations per second (IOPS), transaction times, and overall system responsiveness. Additionally, scalability will be examined based on the cloud platform's ability to dynamically adjust resource allocation in response to changing workload demands. This includes the ability to automatically scale up or down, provision additional resources when required, and optimize resource utilization across compute, storage, and networking components.

Cost efficiency will be assessed through the total cost of ownership (TCO) for each platform, taking into account not only compute costs but also storage, network usage, and any additional costs related to data transfer, licensing, and support. The research will also investigate each platform's capacity for integrating legacy mainframe systems with modern cloud-based tools and services, ensuring that migrations are both seamless and cost-effective. Security, availability, and compliance with industry standards (such as GDPR, HIPAA, etc.) will also be part of the evaluation, as these are critical concerns for organizations moving sensitive data from on-premises mainframes to the cloud.

VI. FINDINGS AND ANALYSIS

The findings and analysis section presents the results of the comparative evaluation of AWS, Azure, and GCP for mainframe workloads. Using the criteria defined in the previous section, the study will detail how each cloud platform performed in various benchmarks and real-world simulations. The analysis will highlight key differences between the providers, such as AWS's strong performance with large-scale compute and storage workloads, Azure's advantages in hybrid cloud environments for Microsoft-based applications, and GCP's focus on containerization and scalability. The research will also uncover any challenges faced during the migration process, such as compatibility issues, performance bottlenecks, or difficulties in integrating legacy systems with cloud-based resources. Additionally, the study will explore the real-world implications of cloud performance, including how each platform's unique capabilities can influence the success of a migration. Insights from organizations that have already undertaken mainframe migrations to these cloud platforms will be incorporated, providing practical examples of both successes and setbacks.

VII. CONCLUSION

The conclusion summarizes the key findings of the research and offers actionable recommendations for organizations considering mainframe migration to the cloud. Based on the comparative analysis of AWS, Azure, and GCP, the paper will provide a clear assessment of which platform is best suited for handling specific types of mainframe workloads. For instance, organizations with a heavy reliance on Microsoft technologies might find Azure to be the most efficient option, while those seeking scalability and advanced machine learning capabilities might prefer GCP. AWS, on the other hand, may appeal to organizations that require high-performance, large-scale compute resources. The paper will conclude by discussing future trends in mainframe migration, such as the rise of hybrid cloud solutions and the potential for serverless computing to handle legacy workloads. The research will also suggest areas for further investigation, such as the role of artificial intelligence in optimizing cloud-based mainframe environments or new cloud-native architectures that could replace traditional mainframe systems altogether.

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