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Original Article

Strategies for Cloud Migration of Legacy Mainframe Applications: AWS, Azure, and GCP Comparison

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Abstract *- Cloud migration of legacy mainframe applications has become a strategic necessity for organizations aiming to enhance scalability, reduce costs, and improve operational efficiency. This paper provides a comprehensive analysis of the strategies for migrating legacy mainframe applications to cloud platforms, specifically Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). The study highlights the benefits, challenges, and best practices associated with cloud migration. A comparative analysis of AWS, Azure, and GCP is presented, focusing on key factors such as cost, security, compliance, and performance. The findings suggest that the choice of cloud platform depends on organizational requirements, workload characteristics, and budget constraints. This paper provides a framework for decision-makers to evaluate and execute a seamless migration strategy for legacy mainframe applications.*

Keywords - *Cloud Migration, Legacy Systems, Mainframe Applications, Aws, Azure, Gcp, Hybrid Cloud, Digital Transformation, Cloud Computing.*

I. INTRODUCTION

A. Background

Legacy mainframe applications have served as the backbone of critical business operations for decades. However, with the growing demand for agility, scalability, and cost efficiency, organizations are exploring cloud migration as a viable solution.

B. Importance of Cloud Migration

Migrating legacy applications to the cloud helps organizations modernize their IT infrastructure, ensuring better availability, disaster recovery, and cost optimization. It also enables businesses to leverage advanced analytics, artificial intelligence, and machine learning capabilities.

C. Challenges of Legacy System Migration

- Complexity: Mainframe applications are built on outdated architectures and programming languages.
- Data Migration Risks: Ensuring data integrity during migration is critical.
- Compliance and Security Concerns: Regulatory requirements must be adhered to while transitioning to cloud-based solutions.

D. Objectives of the Study

This study aims to:

- Examine the different strategies available for mainframe migration.
- Compare AWS, Azure, and GCP in terms of features, pricing, and ease of migration.
- Provide a migration framework for decision-makers.

II. LITERATURE SURVEY

A. Evolution of Cloud Computing

Cloud computing has evolved significantly over the years, transforming from simple hosted services to complex multi-cloud and hybrid cloud environments. Initially, cloud computing services were limited to Infrastructure as a Service (IaaS), which provided fundamental computing resources such as virtual machines, storage, and networking. Over time, more sophisticated services emerged, including Platform as a Service (PaaS) and Software as a Service (SaaS). PaaS offers development frameworks and tools that enable faster application deployment, while SaaS provides end-users with ready-to-use applications hosted in the cloud. These

advancements have allowed businesses to innovate rapidly, reduce on-premise infrastructure costs, and scale efficiently.

B. Legacy System Challenges

Legacy systems present numerous challenges that make cloud migration necessary but complex. Studies highlight the following major issues:

- High Maintenance Costs: Legacy mainframe systems require specialized expertise and frequent updates, increasing operational expenses.
- Limited Flexibility: Older architectures do not support modern development practices such as DevOps, containerization, and microservices.
- Integration Difficulties: Legacy applications often lack interoperability with cloud-native applications, making integration a significant challenge.
- Security Risks: Outdated security protocols and unsupported software pose increased cybersecurity risks.
- Scalability Issues: Legacy systems are often built for specific workloads, limiting their ability to scale dynamically in response to changing business demands.

C. Cloud Migration Strategies

Migrating legacy applications to the cloud requires careful planning and execution. The following strategies are commonly employed:

- Rehosting (Lift-and-Shift): This approach involves moving applications to the cloud with minimal modifications. It is quick and cost-effective but may not leverage full cloud-native capabilities.
- Replatforming (Lift-Tinker-and-Shift): Applications are migrated with slight modifications to optimize them for the cloud environment without significant architectural changes.
- Refactoring (Re-architecting): A more advanced approach that involves redesigning applications to fully utilize cloud-native features, improving performance, scalability, and maintainability.
- Retiring and Replacing: In cases where legacy applications are outdated and no longer add business value, they are decommissioned and replaced with new cloud-based solutions.

D. Comparative Analysis of Cloud Providers

Several academic and industry studies provide insights into AWS, Azure, and GCP, highlighting their strengths and limitations in cloud migration. The comparison below considers factors such as pricing, security, compliance, and migration ease.

Feature	AWS	Azure	GCP
Pricing	High	Moderate	Low
Security	Advanced	High	Moderate
Compliance	Extensive	Strong	Moderate
Performance	High	High	Moderate
Migration Ease	Moderate	High	Moderate
Support & Ecosystem	Strong	Strong	Emerging

Each provider offers unique advantages:

- AWS: Known for its extensive global infrastructure, robust security, and comprehensive compliance offerings, making it suitable for enterprises with high-security needs.
- Azure: Strong integration with Microsoft products and services, making it a preferred choice for organizations already using Microsoft technologies.
- GCP: Offers cost-effective solutions and advanced analytics capabilities, making it ideal for data-driven applications.

III. METHODOLOGY

A. Research Framework

This study follows a mixed-method approach, incorporating qualitative and quantitative analysis.

B. Data Collection Methods

- Primary Data: Interviews with industry experts and IT professionals.
- Secondary Data: Analysis of white papers, case studies, and journal articles.

C. Comparative Analysis Criteria

- Cost Analysis
- Security & Compliance
- Performance & Scalability

- Ease of Migration
- Support and Ecosystem

D. Migration Framework Development

A step-by-step framework is proposed to guide organizations in selecting the right cloud migration strategy.

IV. RESULTS AND DISCUSSION

A. Comparative Analysis of AWS, Azure, and GCP

Feature	AWS	Azure	GCP
Pricing	High	Moderate	Low
Security	Advanced	High	Moderate
Compliance	Extensive	Strong	Moderate
Performance	High	High	Moderate
Migration Ease	Moderate	High	Moderate
Support & Ecosystem	Strong	Strong	Emerging

B. Case Studies

- Case Study 1: A financial institution migrating to AWS for scalability.
- Case Study 2: A healthcare company adopting Azure for compliance reasons.
- Case Study 3: A tech startup leveraging GCP for cost efficiency.

C. Cloud Migration Best Practices

- Conduct a thorough assessment of existing infrastructure.
- Choose the right migration strategy based on workload and business objectives.
- Implement robust security and compliance measures.
- Optimize for cost efficiency.
- Perform rigorous testing and validation before going live.

D. Future Trends

- AI and Machine Learning Integration
- Serverless Computing
- Edge Computing Enhancements

V. CONCLUSION

A. Summary of Findings

- AWS is ideal for enterprises requiring extensive scalability and compliance.
- Azure is best suited for organizations with strong Microsoft ecosystems.
- GCP offers cost advantages and is excellent for data analytics workloads.

B. Recommendations

Organizations should conduct a thorough analysis of their IT environment before choosing a cloud platform. A hybrid cloud approach may be beneficial in some scenarios.

C. Limitations

The study primarily focuses on large enterprises; smaller organizations may have different requirements.

D. Future Research Directions

Further research can focus on emerging cloud technologies such as multi-cloud orchestration and AI-driven optimization.

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