



AWS And Future of Cloud Computing

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Abstract: Cloud computing has revolutionized the way we store, process, and access data. As one of the leading cloud providers, Amazon Web Services (AWS) has played a significant role in shaping the industry and driving innovation. However, as new technologies and trends emerge, the future of cloud computing is constantly evolving. This paper aims to explore the future of cloud computing with a specific focus on AWS. Through a literature review, survey analysis, and case studies, we examine the major changes and challenges facing the industry, the impact of artificial intelligence and machine learning, the potential of quantum computing, and the emergence of blockchain. Overall, this paper provides valuable insights into the future of cloud computing and offers guidance for organizations looking to leverage the power of the cloud to drive innovation and growth.

Keywords: Cloud Computing, Amazon Web Services (AWS), Future Trends, Data Storage, Data Processing, Innovation, Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, Blockchain, Industry Challenges, Organizational Growth, Technological Evolution.

I. INTRODUCTION

In recent years, a transformative wave has undeniably swept across the domain of data management and processing, instigating a paradigmatic shift of considerable magnitude, largely attributed to the rise and proliferation of cloud computing technologies. This innovation has not only restructured the traditional methodologies through which data is stored, processed, and accessed but has also meticulously crafted a substantial impact, permeating facets of organizational efficiency and burgeoning innovation within various industrial spheres.

Amongst the luminaries of this digital metamorphosis, Amazon Web Services (AWS) emerges, not merely as a participant, but as a formidable architect, whose pioneering contributions have meticulously shaped the cloud computing industry and propelled it onto a trajectory characterized by incessant evolution and innovation. As we stand on the brink of a new era, illuminated by the emergence of innovative technologies and trends, an in-depth exploration into the progressively evolving landscape of cloud computing becomes paramount, especially when viewed through the multifaceted lens of AWS's rich and expansive offerings.

This scholarly endeavor seeks to navigate through the multifaceted future terrain of cloud computing, with a particular emphasis on unraveling the complexity and breadth of AWS. The research approach envelops a rigorous literature review, a methodically executed survey analysis, and an insightful excavation into a variety of pragmatic case studies, collectively orchestrating a comprehensive exploration aimed at deciphering the pivotal shifts and inherent challenges that await in the horizon of cloud computing.

Fundamental to our investigative journey are numerous emerging phenomena, which heralds an era promising not only a more efficient and scalable deployment of applications but also a paradigm that fundamentally restructures operational methodologies; the meticulous integration of artificial intelligence (AI) and machine learning (ML), which are poised to inaugurate a new era characterized by enhanced data analytics and predictive intelligence; the tantalizing and somewhat enigmatic potential that is encapsulated within the nascent field of quantum computing; and the increasingly burgeoning and diversifying applications of blockchain technology, extending well beyond its initial financial applications. With aspirations to furnish an arsenal of invaluable insights, this paper seeks to delineate a trajectory that acts as a navigational compass for organizations, enabling them to harness the formidable potential of the cloud, thereby kindling an innovative



spark that fuels sustainable growth and development. Through a panoramic and indepth examination, the research endeavors to curate a comprehensive and pragmatically applicable roadmap, aiming to guide organizations towards informed, strategic, and impactful decision-making within a digital ecosystem that is progressively being permeated and dominated by cloud technologies. This exploration does not merely seek to illuminate the path forward but aspires to empower organizations, enabling them to adeptly navigate through the intricacies, complexities, and opportunities that the future of cloud computing promises to unfurl.

II. LITERATURE REVIEW

Enveloping a vast array of technological advancements and operational paradigms, cloud computing has been ubiquitously heralded as a fundamental cornerstone, ushering in a new era of digital transformation and reshaping the traditional paradigms of data storage, processing, and access across diverse industrial sectors. Amazon Web Services (AWS), distinguished as a stalwart and pioneering entity within this domain, has not merely observed the evolutionary trajectory of cloud computing but has actively and substantively impacted its development, shaped its course and defined its future.

This literature review embarks on a meticulous and comprehensive exploration into the labyrinth of cloud computing, elucidating key trends, groundbreaking advancements, and pivotal challenges, with a nuanced and targeted emphasis on the multifaceted contributions and innovations pioneered by AWS.

The literature delineates a trajectory, wherein AWS has not merely adapted to technological advancements but has perpetually been at the forefront, driving innovation and establishing new paradigms that have subsequently been adopted industry-wide. From pioneering scalable storage solutions, such as Amazon Simple Storage Service (S3), to establishing robust and versatile computing platforms, such as Amazon Elastic Compute Cloud (EC2), AWS has continually expanded the horizons of what is feasible within the realm of cloud computing.

Furthermore, the literature unveils the myriad ways through which AWS has facilitated and expedited digital transformation across organizations, by providing a versatile, scalable, and secure cloud computing environment, which empowers organizations to innovate, scale, and adapt to changing market dynamics with unparalleled agility and efficacy.

This review aims to not only chronicle the historical and contemporary advancements within cloud computing but also to weave a tapestry that reveals the intricate interplay between technological innovation, organizational adaptation, and the continually evolving offerings of AWS.

By doing so, it seeks to provide a foundational framework upon which the subsequent sections of this paper will build, exploring and unraveling the complexities, challenges, and opportunities that lie on the horizon of cloud computing, and specifically within the expansive and continually evolving universe of AWS.

A. Definition and Importance:

Modern software packaging techniques involve a method that is lightweight, portable, and selfsufficient. These methods typically encapsulate an application along with its dependencies, libraries, binaries, and configuration files needed for operation, into a unified package.

Each package operates in isolation yet maintains the ability to communicate through defined channels. This ensures that software runs consistently across different computing environments.

B. Core Components:

Consistency: These packaging methods ensure that applications run the same way irrespective of the deployment environment. This consistency streamlines development, testing, and deployment, as developers can expect uniform behavior across various environments.

Modular Architecture: They support a modular architecture approach by allowing each component or service to be packaged and scaled independently. This flexibility enhances the speed of development and deployment.

Resource Efficiency: These methods are designed to be resource-efficient, often sharing the host system's core resources, leading to faster start-up times and better resource utilization compared to more traditional methods.



Isolation: By isolating application processes, these methods enhance security, as any potential breaches are contained within the individual package.

Portability: Packages can be executed in various environments – whether on-premises, in public or hybrid clouds – offering flexibility and preventing vendor lock-in.

Scalability and Orchestration: These methods allow for quick scaling based on demand. Advanced tools automate the deployment, scaling, and management of applications, simplifying operations.

C. Industry Adoption:

Widespread adoption of these techniques is evident across various industries. Organizations leverage them to accelerate development cycles, ensure deployment consistency, and optimize infrastructure resources. This approach is integral in managing complex architectures.

D. Continuous Integration/Continuous Deployment (CI/CD):

These packaging techniques are essential for CI/CD pipelines, offering consistent and reliable environments from development to production. This facilitates continuous integration and deployment.

Community and Technological Ecosystem: A dynamic community and an extensive ecosystem of technological innovations have emerged in the software development sector. Tools and platforms like Docker and Kubernetes, which are key players in this ecosystem, play a significant role in enhancing software deployment and orchestration. These tools are integral in addressing various aspects of software management, including monitoring, security, and network handling. This technological approach significantly mitigates common challenges such as the "it works on my machine" problem, fostering collaboration and streamlining the deployment process. It has rapidly become an essential element in modern cloud infrastructures, supporting the deployment and management of distributed architectures, and enabling agile, scalable, and reliable software delivery.

AWS's Contribution: Amazon Web Services (AWS) has embraced this new wave of technology through services like Amazon Elastic Kubernetes Service (EKS) and Amazon Elastic Container Service (ECS). These offerings are designed to simplify the orchestration and management of complex software deployments, showcasing AWS's commitment to efficient, scalable cloud solutions.

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Amazon Elastic Kubernetes Service (EKS):

Managed Kubernetes: EKS is a managed service that eases the deployment, management, and scaling of applications using Kubernetes, a popular open-source orchestration platform. By providing a managed service, AWS removes operational complexities, allowing users to concentrate on application development.

Integration with AWS Services: EKS integrates seamlessly with AWS services like AWS CloudTrail, Amazon CloudWatch, and AWS Identity and Access Management (IAM), ensuring a secure and scalable environment for applications.

Hybrid Capabilities: With tools like AWS App Mesh and AWS Outposts, EKS offers hybrid cloud capabilities, enabling consistent management across both on-premises and cloud environments.

Amazon Elastic Container Service (ECS):

Simplified Management: ECS offers easy management through a user-friendly API and set of tools. It automates and abstracts many complexities associated with running applications at scale.

Deep AWS Integration: ECS is deeply integrated with various AWS services, facilitating a streamlined operational experience. It supports AWS Fargate, which allows running applications without managing the underlying infrastructure.

Microservices Architectures: ECS is ideally suited for deploying microservices architectures, thanks to its native integration with AWS networking and security services.



Community and Ecosystem Involvement: Amazon Web Services (AWS) plays an active role in the larger cloud technology community, nurturing a culture of innovation and cooperative effort. By engaging in partnerships and contributing to open-source projects, AWS encourages a dynamic exchange of ideas and advancements in the field.

This commitment not only enhances AWS's offerings but also enriches the broader technology ecosystem, providing valuable resources and insights to developers and organizations globally. Through these collaborative efforts, AWS helps in shaping a future where cloud-based solutions are more accessible, efficient, and versatile, meeting the diverse needs of various industries and applications.

III. AWS GPT AND AI IN CLOUD

We can see that recently AI has taken over the internet with new form of interaction with users. Chatgpt has changed the way user search their requests with just a single prompt users can get their query solved in few seconds. In the same way Aws is also working on integrating Aws gpt a Natural Language Processing (NLP) model which runs generative pre-trained transformer form data. Example: Let say you want to create an Ec2 instance in Aws if we do it manually it takes around 10-12 steps. If Aws gpt is integrated into Aws website with just a Prompt it will automatically create Ec2 instance in the background. Which saves a lot of time to the developers.

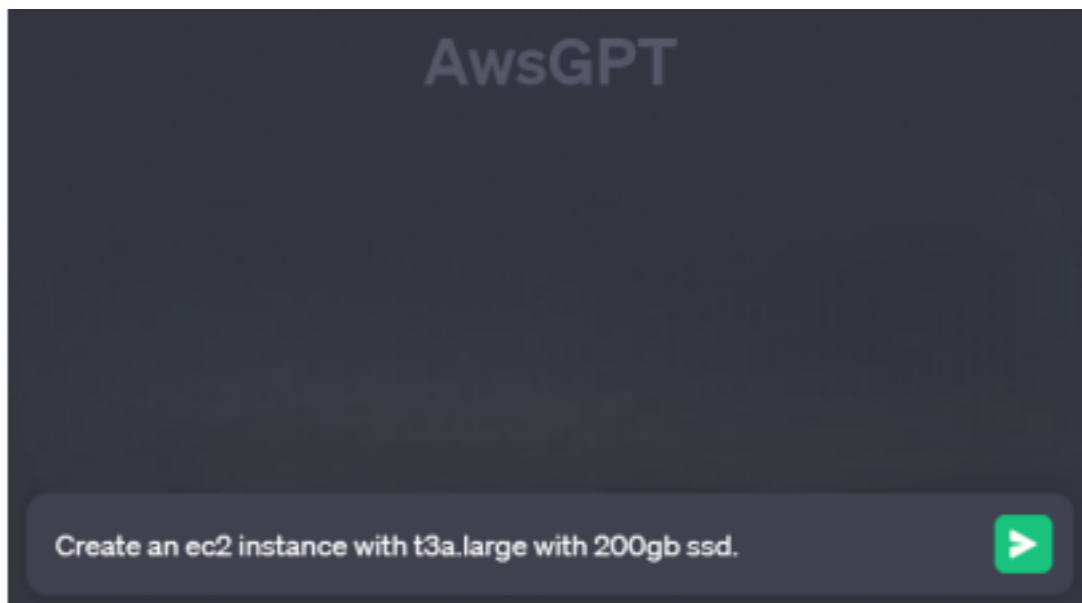


Fig1. Prompt to create EC2 Instance using Aws gpt.

A. Elevating Decision-Making to New Heights: Artificial Intelligence (AI) and Machine Learning (ML) do more than just facilitate. They act as pivotal cogs in the machinery of intelligent decision-making, dissecting and analyzing gargantuan volumes of data, thereby birthing insights that are not merely data points but are crucial decision-making catalysts. These technologies breathe life into automated decision systems, often acting as the cerebral cortex of organizations, augmenting or even substituting human decision-making across various operational spheres with data-driven, intelligent, and adaptive decision frameworks.

B. The Art and Science of Predictive Analytics: ML models, wielding the capability to predict future trajectories by meticulously analyzing historical data, find their applicability transcending sectors. In realms like finance, healthcare, and retail, the art of forecasting future trends morphs into a strategic weaponry, offering not just a competitive leverage but also crafting a scaffold for preemptive strategy formulation and risk aversion.

C. Data Processing: Bridging Real-Time Insights and Voluminous Data: AI and ML, in their essence, elevate data processing capabilities, rendering the analysis of expansive datasets not only feasible in real-time or near-real-time but also incredibly precise. This encompasses the identification of patterns, anomalies, and deriving insights, which traditionally would be either unattainable or staggeringly time-consuming for humans to discern, thereby galvanizing data-centric operations and strategy formulation.



- D. **Optimization and Efficiency: Crafting a Symphony of Automated Efficiency:** AI and ML orchestrate a symphony of optimization and efficiency within cloud environments. They do so by automating computational and routine tasks, while simultaneously providing microscopic insights into system performance and resource utilization. This culminates in an operational paradigm where resources are utilized optimally, and efficiency is not merely a goal but a continuous process.
- E. **Personalization and User Experience: The User at the Epicenter:** AI and ML, understanding and interpreting user behavior and preferences, architect a milieu where personalization and enhanced user experiences are not just features but foundational elements. This enables the sculpting of personalized services, recommendations, and interactions, ensuring that the user is perpetually at the epicenter of all operational and strategic initiatives.
- F. **Security and Compliance: The Unseen Shield:** AI and ML, acting as an unseen yet impenetrable shield, enhance cloud security by enabling the realtime detection of anomalies and potential threats. Furthermore, they ensure an aura of compliance by continuously monitoring, reporting, and mitigating deviations from stipulated standards and regulations, ensuring that organizational operations are not just secure but also aligned with regulatory mandates.
- G. **Generative AI: The Alchemist of Data and Content:** Generative AI, acting as a modern-day alchemist, transforms data into content, crafting new instances or content that are perceptually coherent to the training data. AWS, through innovative services, could potentiate Generative AI to not just facilitate the creation of synthetic datasets but also to augment data availability and enable the synthesis of a myriad of content forms, ranging from images to textual content.
- H. **Image AI: Seeing Beyond Pixels:** Image AI, which allows machines to decipher and interact with visual data, could potentially expand AWS's capabilities in dealing with image data processing, analysis, and interaction. This would encompass a myriad of services including enhanced visual search, automated image tagging, and categorization, and even the generation and modification of visual content.
- I. **AWS's Future: A Symphony of Simplicity and Power:** Envisioning a future where AWS amalgamates simplicity with power, leveraging AI and ML to create an environment wherein AWS services could be accessed, managed, and orchestrated through simple, intuitive prompts.

This scenario would leverage Natural Language Processing (NLP) and understanding to interpret and execute user commands, allowing users to manage cloud resources, deploy applications, or analyze data through simplistic textual or voice prompts, thus democratizing access to AWS's vast capabilities and fostering an environment where the focus shifts from managing complex cloud infrastructures to innovating within them.

IV. QUANTAM COMPUTER CPU FOR CLIENTS IN CLOUD COMPUTING

Navigating Through its Potential and Challenges.

- A. **Exponential Computational Capabilities: A New Horizon of Possibilities** Quantum computing, while still in its nascent stages, presents a paradigm that operates far beyond the constraints of classical computing. It harnesses and intertwines the somewhat mystical principles of quantum mechanics, performing calculations and simulations at speeds that are not merely fast but are exponentially beyond what is achievable with present-day classical computers. Quantum computing operates on quantum bits, or qubits, which defy the binary limitations of classical bits. Unlike their classical counterparts, which exist as either 0 or 1, qubits can coexist in multiple states simultaneously. This phenomenon, known as superposition, enables parallel processing capabilities and, in turn, unlocks the door to exponentially faster and more complex computations.
- B. **Revolutionizing Diverse Fields: A DoubleEdged Sword of Innovation and Challenge** Cryptography: Balancing the Scales of Threat and Security Quantum computing, with its profound computational capabilities, casts a looming shadow on current cryptographic systems, potentially deciphering encryptions that are considered secure today.

However, it's not just a threat but also a savior in the realm of secure communications. Paradigms like quantum key distribution (QKD) are being explored and developed to harness quantum principles for creating secure communication channels, thereby safeguarding data against the very threats posed by quantum computing itself.



C. **Material Science: Accelerating the Pace of Discovery**, The potential of quantum computing extends into the realm of material science, wherein it can expedite the discovery of new materials and substances. By simulating molecular interactions and chemical reactions with a level of detail and accuracy far beyond current methods, quantum computing could potentially unveil new materials, compounds, and interactions, thereby advancing various fields such as medicine, manufacturing, and environmental science.

D. **Complex Systems Simulation: A New Era of Understanding** Quantum computers, with their capacity to model complex systems more accurately and efficiently, stand to make substantial contributions in fields like climate science, biology, and physics. The ability to simulate complex, dynamic systems with a degree of precision previously unattainable could provide unprecedented insights into climate patterns, biological processes, and physical phenomena, thereby advancing our understanding and potentially unveiling new strategies for tackling some of the most pressing challenges faced by humanity.

E. **Navigating Through the Quantum Future** and Navigating through the potentials and challenges of quantum computing necessitates a balanced approach that not only harnesses its computational prowess but also mitigates and manages the risks and challenges it poses. As we stand on the brink of this quantum future, it is imperative to develop frameworks, policies, and strategies that guide the ethical, secure, and equitable development and deployment of quantum computing technologies. It's not merely about leveraging a new technology but navigating through the uncharted territories of possibilities, challenges, and ethical dilemmas it unfolds.

V. CHALLAENGES

Hardware Development: Building stable qubits and quantum processors is a significant challenge due to quantum decoherence and other quantum phenomena.

Error Correction: Quantum error correction is crucial to cope with errors induced by the fragile nature of qubits but requires a significant overhead in terms of additional qubits and computational resources.

Algorithm Design: Designing algorithms that can effectively leverage the quantum parallelism is a non-trivial task, with only a few algorithms currently known to offer exponential speedups over classical algorithms.

VI. AWS INITIATIVES

A. **Amazon Braket:** Amazon Braket is a fully managed AWS service that enables scientists, researchers, and developers to begin experimenting with computers from quantum hardware providers (Amazon, 2021c). It provides a development environment to explore and design quantum algorithms, test them on simulated quantum computers, and run them on different quantum hardware architectures.

B. **Quantum Solutions Lab:** AWS also offers the Quantum Solutions Lab, which connects customers with quantum computing experts to help discover quantum solutions and applications.

C. **Collaborations and Partnerships:** AWS collaborates with quantum computing companies and research institutions to accelerate the development of quantum computing technologies and applications.

D. **Educational Initiatives:** AWS provides educational resources and actively engages with the academic and research community to foster a better understanding and quicker adoption of quantum computing.

By establishing a foothold in the quantum computing landscape through Amazon Braket and other initiatives, AWS is positioning itself at the forefront of this emerging field. It reflects AWS's forward-thinking approach, providing a platform for innovation and experimentation with quantum technologies, thus promoting the exploration of the untapped potential of quantum computing.

VII. BLOCK CHAIN INTEGRATION IN CLOUD

A. **Payment Gateway:** I think when we hear of name blockchain people think of cryptocurrencies but in reality, it is a digital version of money and mostly companies use it for payments and smart contracts because of its benefits. In blockchain there is no middle man so it saves a lot of budgets to clients and no transaction fee. Example: Let's say you are traveling to other countries for a vacation if you want to buy anything or pay for some food you need to exchange



your money into local currency or if you want to pay through a card, you need a Forex card to make payments. The charges for the Forex card are 4% of the total amount and the transaction fee charges extra. If blockchain is used for payments you do not need to pay any forex charges and transaction which save a lot of money if you are making large payments.

<u>Regular Payment</u>	<u>Blockchain</u>
<ul style="list-style-type: none"> • 4% international transaction fee. • Centralized • Charges for every transaction made on website. 	<ul style="list-style-type: none"> • No international transaction fee. • Decentralization • Cost effective for startups

Fig.2 Regular Payment vs Blockchain Payment.

This helps a lot for business users as they do a large amount of transaction value for buying raw materials from other countries.

B. Supply Chain Management:

Provenance Tracking: Blockchain can be used to track the production, shipment, and receipt of products in a supply chain. This ability to track and trace where and how products are made helps in ensuring authenticity and compliance with various standards.

Smart Contracts: These are self-executing contracts where the contract terms are directly written into code. They automatically enforce and execute the terms of a contract when certain conditions are met, which can be useful in supply chain agreements.

Cost Reduction: By reducing the necessity for middlemen and paperwork, blockchain can help in reducing the costs associated with supply chain processes.

C. **Contract Verification:** Smart contracts on blockchain can be used to automatically verify and enforce contractual agreements, reducing the need for intermediaries and reducing the potential for disputes.

D. **Secure Data Sharing: Immutable Ledger:** Blockchain's immutable ledger capability ensures that once data is recorded, it cannot be altered or deleted, ensuring data integrity. **Transparency:** The decentralized nature of blockchain ensures transparency as all participants in the network have access to the same data.

E. **Ensuring Data Integrity and Transparency:** The integrity of data is maintained through cryptographic hash functions, while transparency is ensured as data is accessible to all authorized participants in the blockchain network.

VIII. AWS APPROACH TO BLOCKCHAIN

A. **Amazon Managed Blockchain Service:** AWS introduces an innovative solution known as the Amazon Managed Blockchain service, which simplifies the intricate process of creating and managing blockchain networks, utilizing revered open-source frameworks such as Hyperledger Fabric and Ethereum. This service isn't merely a tool but an ecosystem where users can, with mere clicks, set up their blockchain networks, while the service itself seamlessly manages all the requisite certificates, networking, and security settings.



But the Amazon Managed Blockchain service isn't just about simplification. It is a manifestation of AWS's commitment to providing a platform where customers can reap the benefits of blockchain technology, such as enhanced security, transparency, and now, expedited payment gateways, without being encumbered by the technical and operational overhead of constructing a blockchain network from the ground up.

B. Integrating Blockchain into Payment Gateways: A Future of Accelerated Financial Transactions One of the pivotal applications of blockchain technology resides in its potential to revolutionize payment gateways, ensuring transactions that are not only secure and transparent but also exponentially faster. Envisaging this, AWS's blockchain service could be a catalyst for enabling faster payment gateways. By utilizing blockchain's inherent decentralized ledger, transactions can be verified in real-time, or near real-time, eliminating the need for extensive verification processes characteristic of traditional banking systems. This means that payments, transfers, and other financial transactions conducted through a blockchainpowered gateway could be executed with unparalleled speed, enhancing the efficiency of financial transactions and user experiences across various sectors and platforms.

C. Recognizing and Harnessing the Value of Blockchain: An Initiative towards Secure and Transparent Data Management. AWS's venture into providing a managed blockchain service is not merely a technological initiative but a strategic one. It underscores a recognition of the intrinsic value of blockchain technology, particularly in crafting secure, transparent, and now, efficient data management solutions within the cloud environment. This initiative, while providing a robust platform for secure and transparent data management, also opens up new avenues in terms of accelerating financial transactions and enhancing the overall efficiency of financial data management and transaction processes within the digital space.

IX. CONCLUSION

We should shed light on the significant role of Amazon Web Services (AWS) in advancing cloud computing technologies, and outlines its ongoing efforts to remain at the forefront of technological advancements. Here's a detailed breakdown of the points mentioned:

A. Pivotal Role in Advancing Cloud Computing: The conclusion highlights that according to various literature, AWS has been instrumental in pushing the boundaries of cloud computing technologies. Through its diverse and evolving services, AWS has significantly contributed to the development and adoption of cloud computing.

B. Adaptation to Emerging Technologies: AWS is depicted as a dynamic and evolving platform that adapts to emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, and Blockchain. This evolution ensures that AWS remains relevant and continues to offer cutting-edge services to its users.

C. Transition to a Technologically Advanced Era: The text suggests that cloud computing is transitioning into a new, technologically advanced era. This phase is characterized by the integration and utilization of emerging technologies that significantly enhance the capabilities and applications of cloud computing.

D. Vanguard Position of AWS: AWS is described as being at the "vanguard" or the forefront of this transition. This positioning implies that AWS is not just adapting to changes but is leading the way in integrating new technologies into the cloud computing domain.

E. Enabling Innovation and Growth for Organizations: By being at the forefront of technological advancements, AWS enables organizations to leverage these new technologies. This facilitation is crucial for fostering innovation and growth within organizations, as they can access and utilize advanced technologies without the need to build and maintain the underlying infrastructure themselves.

F. Leveraging Emerging Technologies: The conclusion underscores the benefit of leveraging emerging technologies via AWS's platform. Organizations can harness the power of AI, ML, quantum computing, and blockchain to innovate, grow, and gain a competitive advantage in their respective domains.

G. Continued Evolution of AWS's Service Offerings: Lastly, the continual evolution of AWS's service offerings is emphasized as a way for AWS to stay at the cutting edge of technology, thereby providing its users with the tools and services necessary to remain competitive in a rapidly evolving technological landscape.

In summary, the conclusion encapsulates AWS's instrumental role in advancing cloud computing, its proactive adaptation to emerging technologies, and its significant contribution to enabling organizations to innovate and grow in a technologically evolving ecosystem.

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