

Combining Cloud Computing and AI and Its Effects on the Telecom Industry

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ABSTRACT

Artificial intelligence (AI) and cloud computing (CC) are two emerging business technologies that will enable organizations to transform into smarter businesses that will provide services to their clients in a way that best meets their needs—that is, quickly, effectively, and affordably. In this study, the implementation of CC and AI in the top Middle Eastern telecom company, MGA-MENA, is examined. A Smart MGA-MENA Company's operational services, product efficiency, and overall quality of products and services are enhanced through the application of the twin technologies of cloud computing and artificial intelligence. From this, it can be concluded that cloud computing and artificial intelligence present a new and sophisticated commercial possibility for large telecom firms like MGA-MENA, which have a wide client base and numerous transactions every minute

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1. INTRODUCTION

Since cloud computing depends on resource sharing, which enables businesses to introduce new products and services across multiple industries, the shift towards cloud computing (CC) has advanced significantly in the current era of digital transformation. CC replaces traditional network communication architectures with a new model with the goal of increasing agility and lowering operating costs. One way to characterize cloud computing is as an IT paradigm that allows for widespread access to shared pools of programmable system resources and higher-level services that can be quickly supplied with little admin work, frequently via the Internet. Because of this, there is an enormous amount of data from transactions, storage, and connected devices, which opens up new avenues for competitive advantage and helps telecoms survive in extremely competitive environments. This means that the telecom industry must focus solely on providing connectivity and offer solutions and services. A well-known telecommunications company, MGA-MENA Company, for instance, has implemented cloud computing models that have significantly improved its services and are currently operating in 16 countries across the Middle East, Asia, and Africa. The company aspires to be the smart one using artificial intelligence to run its operations and manage customer experience. Cloud computing and artificial intelligence (AI) are two amazing technologies that are truly revolutionizing the telecommunications industry.

This energetic pair is looking to change the way communications work, networks are managed, and services are delivered to consumers. Cloud Computing: Enterprise Imagine a large collection of database servers storing computing resources that can be accessed on-demand over the Internet. This is the essence of cloud computing. Telecommunications companies can use this flexible infrastructure to reduce costs, eliminate the need for costly physical infrastructure and maintenance, and increase scalability by scaling resources to meet changing requirements. Bring flexibility to life by deploying new services and applications faster and more efficiently using an intelligent AI layer. Telcos can analyze massive amounts of network data using machine learning algorithms to optimize the network, if they can identify and find bottlenecks, proactively improve congestion and keep data flowing. Anticipate network issues that will cause problems during chassis maintenance, and that will require

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maintenance before downtime occurs. Personalize the customer experience through usage patterns across diverse services, allowing you to create a personal datagram, and provide proactive support. Transformative impact: Cloud and AI are being combined to give the telecom industry a lot of benefits. Better network efficiency: AI-powered optimization increases network utilization, increases capacity, and reduces costs. Security-enhancing AI can more effectively detect and stop cyberattacks, protecting sensitive data and network integrity. Personalized service, proactive problem resolution, and faster response times lead to happier customers. Innovation Opportunities The ability to analyze data and develop new services faster creates new revenue streams by automating operations tasks, freeing up human resources for more productive activities. Challenges and Considerations: Since the satellite is there, there is one issue that concerns a lot of the words spoken by security: transferring data to the real cloud with sensitive data; Integrated legacy systems have met cloud-based AI loss with careful planning and execution. Skills Gap: The most important industry is the best AI employees can create. The way forward: The telecommunications industry is in the midst of a major transformation with the growth of cloud and artificial intelligence technologies. By leveraging this convergence, carriers can unlock new opportunities, improve network operations and provide superior user experiences.

2. LITERATURE REVIEW

To start, basic studies of cloud computing on telecommunications greatly influence telecommunications-based cloud computing. There are many advantages in this field, capital, business, marketing, customer protection, business financing, attention and more. Cloud computing helps telecommunications in a different way. They can focus on providing services with the highest possible level of satisfaction to their customers as they are not hampered by computing issues, which are essentially tools to achieve business goals. Ten slots, A better way to use cloud computing is to use cloud computing [1]. Study Volgens 'n bykomende, Die Opkoms Vanwe Electronic Electronic The traditional strategy process is becoming increasingly inadequate as a result of technologies that are fundamentally changing the nature of the modern business environment. To remain useful in the age of artificial intelligence, digital reengineering, and cognitive computing, strategy development methods must be updated. This is a key factor in Dubai being successful in e-care, as it has a world-class IT infrastructure, accommodation based on innovative ideas, excellence in cutting-edge financing, and a significant decline in e-participation through burgers and claims. [2] Volgens is turning to using artificial intelligence in telecommunications to help go beyond customer profiles and pass on services in order to capture the preferences of specific customers. Besides, AI helps the operations team by predicting system failures and fixing problems quickly.

AI can also help meet better clients. Vodafone, for example, has a chatbot called TOBi designed to help customers solve problems and questions online. As a result, customer satisfaction will increase.[3] It is assumed that besides the greatest connections between the many people who use CC and AI, create them. During his time, the sector he ran reeked of working for himself. As ad hoc web development (AI), this is the sector that mainly relies on artificial intelligence. The widespread use of the Internet reeks of powerful cloud computing — robots providing the cloud, and enjoying what is very large, on a massive scale. Cloud bots have become quite new and can be described as aiming to develop and provide these things. Robots, which are invading humans, industry, mobile phones, and other species, are things that are served by success. Technology applications, which were often the result of collaboration between well-known IT companies and robotics manufacturers. [4] As the telecommunications sector currently faces a variety of operational challenges, such as design, maintenance and management, AI will offer a number of benefits to the sector. In order to successfully manage their complex and volatile operations, telecom companies need to be able to make wise choices. Machines are capable of analyzing huge amounts of data obtained as a result of data mining via deep learning and training data that companies currently have access to. If AI improves in handling data, the amount of decisions made in this sector will also increase. [5] Telecommunications companies benefit from artificial intelligence and cloud computing because they allow greater attention to security, which is especially important due to the increase in security issues resulting from losses and network disruptions. Artificial intelligence has improved the security of systems, and machine learning is being used to identify attacks without disturbing a human. As a result, the number of attacks occurring has decreased, benefiting both users and businesses. [7] Due to telecom companies' continued growth in the number of customers they serve, it is now impossible for people to evaluate the vast amount of data available for use in the industry.

3. PROBLEMS AND CHALLENGES

3.1 Security and Privacy

Telecom operators are confronted with greater security and privacy concerns as they depend more and more on cloud-based infrastructure and AI technologies. Robust security measures are necessary for storing and processing significant amounts of confidential customer data on the cloud to guard against cyberattacks, illegal access, and data breaches. In order to secure client privacy, AI systems must also abide by data protection laws.

3.2 The network Infrastructure

Massive volumes of data must be transferred between devices, data centers, and edge computing nodes as a result of cloud computing and AI applications in the telecom sector. The bandwidth, latency, and reliability requirements on the network infrastructure are high as a result. To accommodate the rising data traffic and provide continuous connectivity, telecom carriers need to make significant investments in strong network infrastructure

3.3 courses in data management and Integration:

AI and cloud computing both depend on enormous volumes of data for decision-making and training. Diverse and dispersed data sources from different systems and devices are frequently available to telecom operators. It might be difficult to integrate and manage these data sources; integration, normalization, and data cleansing are necessary. Furthermore, for AI to be effective, data consistency, accuracy, and quality must be guaranteed.

3.4 Capacity and Skills a gap:

Qualified individuals who can create, implement, and manage these technologies are needed for the telecom sector to successfully adopt cloud computing and artificial intelligence. However, it is difficult for telecom operators to attract and keep qualified staff due to the lack of professionals in AI and cloud computing. To fully utilize these technologies, it is imperative to close the talent and skills gap through training and upskilling initiatives.

3.5 Legal and Regulatory Issues

The telecom sector works in a highly regulated environment. Artificial Intelligence and cloud computing use provide new legal and regulatory challenges. When working with cloud-based systems and AI algorithms, compliance with data protection, privacy, and security standards becomes more difficult. In order to guarantee that their cloud and AI installations comply with applicable rules, telecom operators must manage these legal considerations.

3.6 Concerns about Ethical and Bias

AI systems utilized in the telecom sector need to be impartial and ethically sound in both their design and training. When AI algorithms decide on things that affect customers, such tailored pricing or service suggestions, questions about justice, responsibility, and transparency surface. In addition to establishing ethical standards for the use of AI in their operations, telecom operators must put policies in place to mitigate bias and guarantee openness in AI decision-making

3.7 The combination and legacy systems

It is common for telecom operators to have a variety of intricate legacy systems that were not intended to be compatible with cloud computing and artificial intelligence. It can be difficult and time-consuming to integrate these systems with AI platforms and cloud-based solutions. Modernization and legacy system compatibility concerns need to be resolved in order to fully reap the benefits of artificial intelligence and cloud computing.

A complete strategy including technology advancements, legal observance, personnel development, and ethical considerations is needed to address these issues. Once these barriers are removed, telecom operators will be able to leverage AI and cloud computing to improve consumer experiences, spur innovation, and streamline operations.

4. DATA COLLECTION

MGA-MENA has become the leader in the ICT sector in the United Arab Emirates thanks to artificial intelligence and cloud computing. An all-inclusive database containing information about client connectivity, network performance, and data traffic is now possible for MGA-MENA Engineering thanks to cloud computing. This made Engineering able to transition from a reactive to a proactive organization, with AI playing a significant

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role that will likely grow over the next several years. In order to provide EXPO2020 in Dubai with a state-of-the-art digital experience for the 25 million expected visitors, MGA-MENA Company is also building two state-of-the-art Points of Presence (POPs). These POPs will be fully cloud based and integrate artificial intelligence to represent a future telecom network "The integration of cloud computing and artificial intelligence (AI) is having a significant impact on various industries, including telecommunications. When these technologies combine, the term "cloud AI" is replaced by "cloud AI." Here are a couple of good words for required data or these words written in English:

A. Analyze and analyze the data

Collect the word data through telephone communications. Telecom companies have used AI in the cloud to manage and analyze their data. Case studies on how to do this could focus on how well AI algorithms hosted on cloud platforms analyze this data to learn about network performance, customer preferences and predictive maintenance.

B. Network optimization and service optimization

AI can optimize network traffic and predict load balancing, which is critical to maintaining quality of service. – Using AI in the cloud for real-time analysis can use a word to guide bandwidth allocation.

C. Customer Service and Experience

Chatbots and virtual assistants, developed over a 24-day period through unique experiments, are cloud-based AI applications that consumers can do. – Before and after implementing these AI solutions, data can be collected on customer satisfaction metrics.

D. Cost reduction and operational efficiency

Telecom companies can reduce capital expenditures and operational expenditures by automating various processes using cloud-based artificial intelligence. – Kry Educating telecom companies with AI in their overall cloud computing strategy or contributing to efficiency.

E. Innovative services and new revenue streams

Telecom operators can quickly deploy AI services with the cloud, allowing them to offer new and innovative services to their customers. – Data can provide word from a variety of communication services that are used by cloud AI, so that they are personally provisioned, providing smart home services and enhancing their security

F. Security and compliance

Artificial intelligence can help detect and respond to security issues more quickly and effectively. - The impact of AI in telecommunications can simultaneously evaluate your data or its security incidents, response advantages, and dealing with regulations such as the General Data Protection Regulation.

J. Infrastructure as a Service (IaaS):

Communications services provide large cloud services. They can improve their IaaS offerings by offering smarter, scalable solutions using AI. - Data on telecom industry adoption and performance of AI-powered IaaS solutions can be useful.

H. Challenges and limitations

The issues of data privacy and security, and the necessary use of individuals in artificial intelligence systems, are fundamental issues. - The data needs English words from the blocks that the telecommunications industry wants to obtain through the implementation of artificial intelligence and cloud computing. This is more than just a global perspective.

Table.1 Criteria Of The Research

	The criteria for inclusion	Exclusion criteria
A	Articles that have already been released	Pieces written in language other than English
B	Online access to open sources is available	Articles that are not publicly Accessible
C	Articles, studies and talks at conferences	Not scholarly articles
D	Available in English only	Research not related to the terms
E	Reviewed articles from the Peer-reviewed Journal.	In the dataset ,duplicates articles

5. DIGITAL TRANSFORMATION STRATEGY

GMA-MENA In order to carry out its AI-driven digital transformation strategy, the organization has a clear roadmap. The telecom network was transformed from a legacy architecture to a telecom cloud architecture to deliver smarter and faster service to customers, enhance operation procedures, and facilitate fast deployment of network technology. This touched on the infrastructure architecture, network itself, and data storage techniques, and was made possible by the implementation of data centers, network function virtualization, NFV, and software-defined networking (SDN). Due to the numerous demands for features and capabilities that the previous system was unable to meet, this was necessary. terms of vendor selection and divided hardware, this redesigned engineering and IT infrastructure is more nimble and versatile, requiring less hardware overall.software, a shortcoming of the old network. This indicates that telecom is moving toward a more software-based architecture with centralized controlling (referred to as an orchestrator in telecom parlance), which functions as the brain and is supported by contemporary Application Programming Interface APIs that enable MGA-MENA to transfer service resiliency from hardware to software. As such, it is imperative to ensure that the Selected vendor adheres to Cloud Intelligence architectural requirements and supports MGA-MENA Company. In telecom equipment, for example, NMS software is taking the place of hardware, and some mobile core systems—such as Evolved Packet Core EPC—are going virtual over cloud networks to take advantage of NFV infrastructure and create opportunities for intelligent operation facilitated by AI and machine learning, allowing MGA-MENA engineering to have highly optimized, effective Gigabit Passive Optical Network (GPON) has a penetration rate of over 92% in inhabited regions, and MGA-MENA updated the topology of their access network to fiber via GPON in order to become more nimble. Virtual Customer Premises Equipment (vCPE), which enables the movement of data, is currently being added to the network to further improve it.

some router functions to the cloud. This will support MGA-MENA Company in streamlining and accelerating service delivery and pave the way for innovative services or solutions. Phase one of this primarily targets enterprise, and it will allow MGA-MENA Company to implement AI or machine learning at the forefront of this solution in order to improve customer experience, deliver new products more quickly, and improve service management [17]. Another change is the shift of the mobile access network from a cloud-based or virtual radio structure to a silo site structure.By pooling Baseband Units (BBUs) in central exchanges, Access Network vRAN can be accessed. Front haul connectivity will run from POP to the last mile, enabling intelligent service provisioning to customers in terms of bandwidth requirements, traffic streaming, and mobility connectivity.

Table.2 Examples of AI and CC threat and mitigation table Effects on the Telecom Industry

	Type	Description	Impact telecom sector	Explanation	References
A	AI in the cloud	Telecom firms can access AI models and algorithms remotely because they are hosted on cloud platforms	cost savings, increased client satisfaction, and improved network performance	Telecom firms can boost network efficiency, cut expenses, and offer customers customized services thanks to cloud-based AI	5,1
B	AI-driven Network Management	In order to increase productivity and decrease downtime, AI algorithms are employed to manage and optimize telecom networks	decreased expenses, increased customer satisfaction, and better network performance	Telecom firms may lower costs, improve network performance, and provide clients customized services using AI-powered network management	7,3,12
C	Forecast-Based Upkeep	To minimize downtime and increase network dependability, AI algorithms are used to forecast equipment breakdowns and schedule maintenance.	increased client satisfaction, lower expenses, and improved network reliability.	With the use of predictive maintenance, telecom firms can enhance customer service, decrease downtime, and increase network reliability	8,11
D	AI systems and Digital Helpers	Chatbots and virtual assistants with AI capabilities are utilized for customer service and work automation	Enhanced client satisfaction, lower expenses, and higher productivity	Personalized customer service, cost reduction, and increased efficiency are all made possible for telecom companies by chatbots and virtual assistants.	1,9
E	Identification of Fraud	In telecom networks, fraud is identified and stopped by AI algorithms, which lowers losses and boosts security.	increased consumer satisfaction, decreased losses, and improved security.	Telecom firms may reduce losses, boost security, and give customers better services by using fraud detection.	15,13,10

6. OPERATIONAL SUPERIORITY

The combination of cloud computing and artificial intelligence (AI) enables engineering to take advantage of cloud services with network function virtualization (NFV) to record all network events and initiate machine learning through orchestration powered by integration with multiple database sources, virtual networks, and SDN. This continuous improvement of the customer experience will result in the provision of creative self-care portals to customers and the maintenance of optimal network performance through self-healing. Furthermore, with an artificial intelligence-powered NFV network, automated network optimization is possible. This is made possible by the AI engine's data analysis from a variety of sources and knowledge databases, as well as machine learning, which improves support for traffic optimization, resource relocation, failure prediction, and continuous network assurance. Because they are no longer burdened with numerous repetitive duties, the operation personnel can concentrate on areas where they are skilled, helping MGA-MENA cut down on OPEX and improve its response to network problems and auto fault restoration. Though only available for services or networks on Cloud/NFV, the usage rate is currently low, and the goal is to have over 20% of operation activities completed by AI. Auto self-healing, auto capacity planning on the access network side, and the self-service portal (Motiv) are three examples of the benefits examined in MGA-MENA. Customers can use the MGA-MENA App to troubleshoot their e-Life line services, starting with Motiv. The system will analyze the client's problem in detail and make the necessary changes and corrections without requiring the consumer to call the MGA-MENA Company. This kind of solution, which was not achievable over a traditional network, can resolve over a million cases. The other is network self-healing, in which millions of data, such as network behavior, network traffic, and NMS alarm indications, are continuously monitored and analyzed to predict any potential failure with end-to-end performance evaluation. Here, artificial intelligence verifies the network thoroughly, including determining whether a planned outage is occurring in order to best reroute traffic and allocate necessary resources. auto capacity assessment, a technology that is presently in its infancy and is carried out manually by examining data from several sources, including forecasts, system connection inventories, and CRM. Then, an annual—and more recently, biannual—plan is established for the expansion of the access network system. This is a drawn-out procedure that requires professional planning. But, AI will analyze data

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frequently from all sources to create a solid plan and decrease error from current practice. This is because the system will learn from CRM, the velocity of demand in a specific area, the resources that are available, and it will enrich with updated forecasts. As a result, the plan will be in place for the ideal time to expand, the volume of connection required, the type of customers, and the load per system based on requested services to prevent any system congestion.

7. STRATEGY FOR PRODUCT DEVELOPMENT

With machine learning and a service orchestrator, MGA-MENA Company has developed a system that can learn from customer experience and promptly make decisions or recommend solutions for client needs. Support for this also comes from the MGA-MENA Company's earlier-highlighted plan to deploy vCPE, which will increase revenue and satisfy customers. In comparison to traditional lock contracted services where provisioning of specific parts takes time, vCPE will allow targeted business customers only to select the services they need at this stage. Then, the process will start automatically to provision the needed services, completing system allocation, optimizing routes, configuring virtual resources, and making the service ready for use and adjusting based on need in a short amount of time. manually and with assistance from people. Using Instagram or another popular mobile data application as an example, we may find the optimum international route for a particular type of mobile data traffic and use it to offer the best possible client experience. Another example of how MGA-MENA benefits from the conversion of IPTV under the e-life package to NFV & SDN is the digital store, which uses AI-powered analytics of customer usage, interest, and favorites to provide each customer with an engaging and personalized experience. This data capture allows for the recommendation and customization of VoD on the main screen, as well as the recommendation of VoD-related content to be watched sooner rather than later. Furthermore, The innovative e-Life TV interface and the way that MGA-MENA Company has changed telecom operations to create a unique experience for each client and present to them depending on their profile, as well as differentiation for adults and children, have earned them an award.

8. ANALYSIS

To determine the benefits of cloud computing and artificial intelligence correlation—where cloud computing and AI are interrelated technologies that support the telecom industry's ability to be more agile, deploy services more quickly, and operate more intelligently—the qualitative data was analyzed based on important concept-related work. Later, coding was done. It was evident from this correlation that service providers could enable intelligent capacity planning, self-healing, auto network optimization, and continual customer experience improvement in an autonomous manner. Telecom gains from this association when it transitions from hardware to software to handle service delivery, which leads to the adoption of software-defined networking and Artificial intelligence-powered virtualized network operations allow telecom to build logic on top of them, enhancing their capabilities and demonstrating a clear connection to the concept we proved. This is made possible by high computational power. Compared to traditional telecom networks, this is seen as a significant transition because of the growing need for customized networks, which has rendered it impossible for the sector to run its operations without artificial intelligence. The outcome of this relationship, in addition to the advantages seen in how MGA-MENA has updated its network as intelligence and changed how it operates, deploys services, and responds to client experiences unattainable across networks using outdated technology. In addition to numerous efforts in the works to carry out MGA-MENA's aim to become a smarter firm, the correlation between the two represents the competitive advantages that MGA-MENA may access. Success will depend on a number of variables, including compliance and security concerns, the regulations that must be in place to oversee this strategy, and the effective data storage necessary to develop an intelligence logic. Telecommunications companies must also remember that machine learning and deep learning methods demand a large number of calculations to be made extremely rapidly, which means they consume a lot of processing power. Therefore, algorithms and logic must be effective and apply real-world use cases to prevent over using

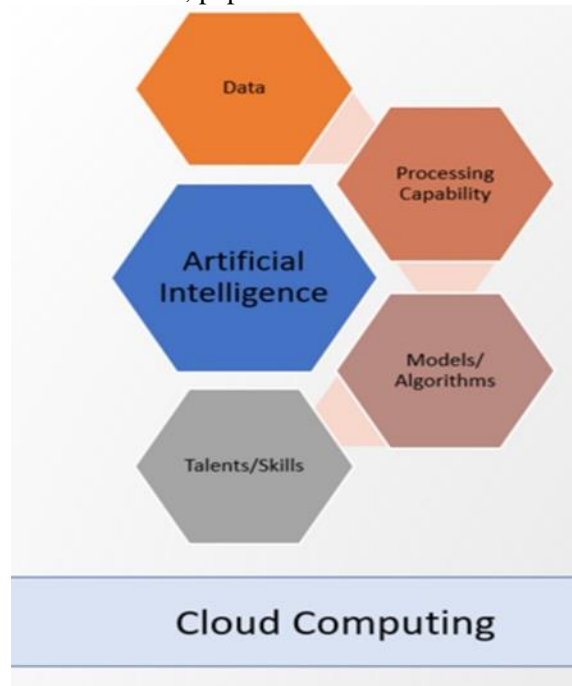


Figure.1 Cloud Computing Analysis

9. USING AI AND CLOUD COMPUTING TOGETHER HAS THESE BENEFITS

1. Elasticity and Scalability: AI applications can be scaled to meet demand thanks to the infrastructure that cloud computing provides. Optimal performance and cost-efficiency can be guaranteed by telecom operators by dynamically allocating computing resources to support AI workloads.

2. advanced Data Processing: Telecom operators can process and analyze massive amounts of data needed for AI algorithms thanks to cloud computing's high-performance computing capabilities. Predictive analytics, pattern recognition, and improved data processing are made possible by the marriage of cloud with AI.

3. In real time Decision-making: Telecom operators may process and analyze data in real-time, leading to quicker and more accurate decisions, by combining cloud computing and AI. Operators may improve customer service, troubleshoot issues quickly, and optimize network performance using real-time insights.

4. Customized consumer Experiences: Telecom companies can provide customized services and experiences by integrating AI algorithms with cloud-stored consumer data. The processing and storage capacity needed to manage enormous volumes of client data and provide personalized suggestions and services is made possible by cloud computing.

5. The network Optimizing and Automation: Communication companies may anticipate network congestion, optimize network resources, and automate network management chores by combining cloud computing and AI. This enhances network functionality, lowers downtime, and makes effective use of available network resources.

10. IMPLICATIONS FOR THE TELECOM SECTOR

1. Enhanced Operational Efficiency: By automating repetitive tasks, optimizing resource allocation, and minimizing manual intervention, cloud computing and AI enhance telecom operations. As a result, operators can increase productivity, distribute resources more wisely, and concentrate on higher-value tasks.

2. Improved Customer Satisfaction: Telecom operators can now offer individualized services, pro-active customer support, and customized marketing campaigns thanks to the combination of cloud computing and AI. Increased loyalty, lower turnover rates, and more customer satisfaction are the outcomes of this.

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3. Cost Optimization: By providing on-demand resource allocation and cost-effective infrastructure, cloud computing helps telecom operators cut down on capital expenses. When AI is combined with resources, operators may minimize energy use, prevent overprovisioning, and optimize resource usage, all of which save money.

4. Accelerated Innovation and Time-to-Market: Telecom operators can quickly create and implement cutting-edge services and applications thanks to cloud computing and artificial intelligence. The capacity of AI to automate procedures and extract insights, along with the scalability and agility of cloud platforms, expedites the release of new goods and services.

5. Improved Connection Secure: Strong security features including data backups, access controls, and encryption are offered by cloud computing. Operators may boost network security and defend against cyber threats by combining AI with advanced algorithms for threat identification, anomaly detection, and real-time security monitoring. **With its better operational efficiency, individualized client experiences, cost optimization, rapid innovation, and increased network security, cloud computing and AI together are revolutionizing the telecom sector. These factors support the industry's expansion, competitiveness, and capacity to satisfy changing consumer demands in the digital age.**

11. CONCLUSIONS

The majority of telecom companies are working to modernize their legacy networks through network function virtualization and software-defined networking in order to compete in a rapidly changing environment. This effort has resulted in a significant advancement toward cloud computing. After several years of operation, MGA-MENA Company's network is now more current. Moving to the cloud alone won't cut it, though, as intelligent decision-making to manage intricate and dynamic operations becomes essential. Humans are unable to analyze vast amounts of data, so artificial intelligence (AI) plays a critical role in enhancing cloud value and improving traffic classification, network fault prediction accuracy, time optimization, and customer services. Therefore, it has been determined that cloud computing and AI make better business models. Nonetheless, telecom firms with a sizable client base and a lot of activities going on at any given moment might benefit greatly from the AI and cloud computing approach. The study makes a small but significant contribution to our understanding of how huge company operations, such as telecommunications, can become more efficient through managerial and technical advancements like the fusion of artificial intelligence and cloud computing.

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