# Cloud Computing Services for Distributed Mobile Devices

**Ramiz Salama[1*], Chadi Altrjman[4], Fadi Al-Turjman[2, 3]**

[1]Department of Computer Engineering, AI and Robotics Institute, Research Center for AI and IoT, Near East University Nicosia, Mersin 10, Turkey

[2]Artificial Intelligence, Software, and Information Systems Engineering Departments, AI and Robotics Institute, Near East University, Nicosia, Mersin10, Turkey

[3]Research Center for AI and IoT, Faculty of Engineering, University of Kyrenia, Kyrenia, Mersin10, Turkey

[4]Department of Chemical Engineering, Waterloo University, ON N2L 3G1, Canada

*Corresponding author Email: ramiz.salama@neu.edu.tr

## Abstract

The advantages of cloud computing and mobile computing are combined in mobile cloud computing (MCC), which provides mobile devices with ubiquitous access to services, increased processing power, and storage capacity. In conventional cloud computing models, mobile devices use the internet to access centralized cloud resources. However, centralized systems have limitations in terms of responsiveness and efficiency as mobile apps become more complex and require real-time processing, faster performance, and lower latency. In response to these issues, a paradigm known as Distributed Mobile Cloud Computing (DMCC) has surfaced, in which cloud resources are dispersed over several sites, frequently nearer to the end users. This distributed architecture optimizes bandwidth utilization, lowers latency, and improves service availability by offloading processing activities from mobile devices via edge computing, fog computing, and cloudlets. DMCC makes it possible for resource-intensive applications to function well on mobile platforms, including augmented reality (AR), real-time data analytics, and sophisticated biometric authentication. Scalability, fault tolerance, and energy efficiency are promoted by the architecture's distribution of computational activities over a network of nearby and distant cloud resources. But it also brings with it additional difficulties including system complexity, effective resource allocation, and security threats. The basic ideas, design, and uses of distributed mobile cloud computing services are covered in this paper. It highlights the potential of DMCC to transform next-generation mobile applications and services by examining important technological issues and providing insights into new solutions.

**Keywords:** cloud computing, cloud computing services, and mobile cloud computing

## 1. Introduction

Numerous modeling techniques, including as software as a service, online storefronts, community networks, and cloud computing, have been developed as a result of advancements in network-based computing. By offering remote access to material and apps, cloud computing enables third-party providers to offer services from any location, at any time, and in a variety of circumstances.

A pay-per-use service, cloud computing offers software, memory, processing power, and storage as needed. Data centers, virtualization, and on-demand computing are its three main technologies. Resource consumption is optimized by task dispersion. Mobile Cloud Computing, which centralizes computers and services for clients, has arisen with the popularity of smartphones.
Distributed computing systems can be built using mobile devices, where each node is specified by a wireless communication architecture and a device [1–3]. As a result, Mobile Cloud Computing (MCC) has become popular, overcoming the limitations of mobile devices in terms of processing, storage, and networking. The main strategies for distributed cloud computing, important characteristics, and important mobile cloud computing technologies are covered in this review study.

## 2. Models for Cloud Deployment

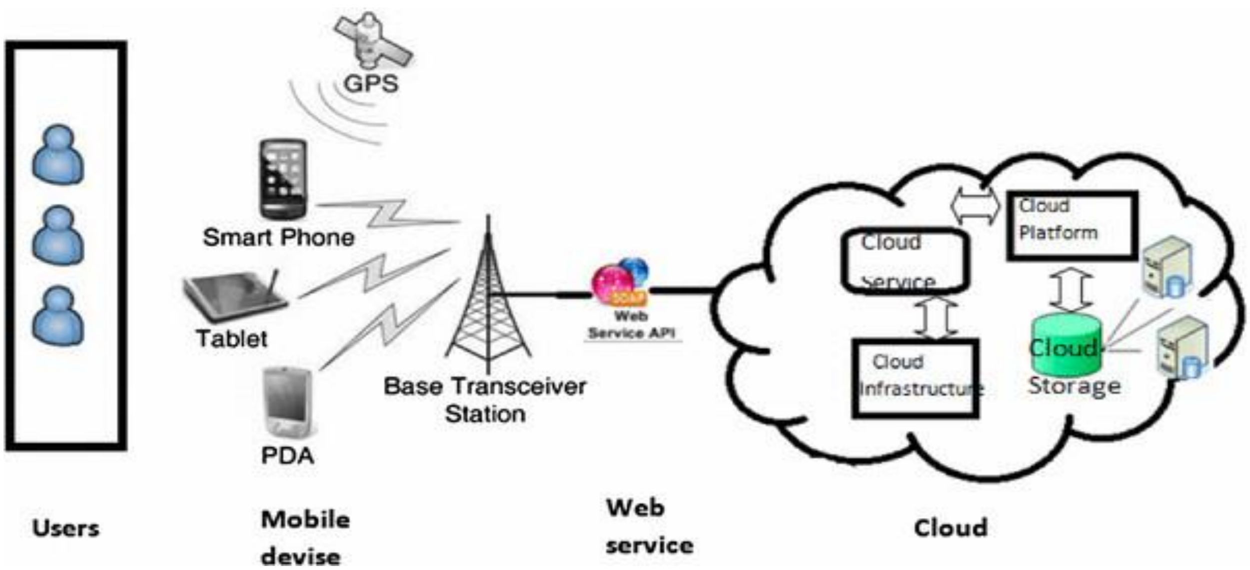


**Figure1** Mobile Cloud Computing

Different application models based on service models can be implemented using cloud computing; Kumari and Singh (2021) have identified four main ones.
1) Private clouds provide improved data security, flexibility, scalability, and dependability and are customized for specific businesses or organizations.
2) Because of their widespread accessibility and suitability for storing non-sensitive data, public clouds—which are run by hosting companies—offer shared resource pools for service delivery, raising security concerns.
3) Deploying a community cloud entails sharing cloud infrastructure across several organizations in the community. This enables cooperative management by the community or a cloud service provider and permits remote access to stored files.
4) Hybrid cloud architecture combines public and private clouds to store data while preserving their unique identities for different deployment circumstances.

## 3. Models of Cloud Computing Services

With three tiers according to capacity and service provider model, cloud computing leverages computers, hardware, and networks to provide services. Customers may control components like operating systems and applications without having to worry about infrastructure upkeep thanks to Infrastructure as a Service (IaaS), which offers virtual computing resources like virtual machines. Using programming languages, resources, and tools that the cloud operator provides, PaaS is an internet-based platform for creating and sharing technologies and applications. By providing computer language libraries and tools for the development and deployment of applications, it makes software development easier. SaaS is a type of software delivery in which users obtain software over the cloud. Grid computing, parallel computing, and distributed computing are all included in cloud computing. For effective workload allocation, load balancing is essential. Cost reduction, geo-replication, redundancy, and dependability are all benefits of distributed cloud computing. It enhances data localization while reducing expenses and overheads associated with connectivity. Effective management of user needs requires efficient resource allocation [4–10]. Concerns about latency have led to the adoption of distributed clouds, particularly in data center-intensive scenarios such as cooperative document editing or gaming, where local clients include computers, robots, self-driving cars, and humans.

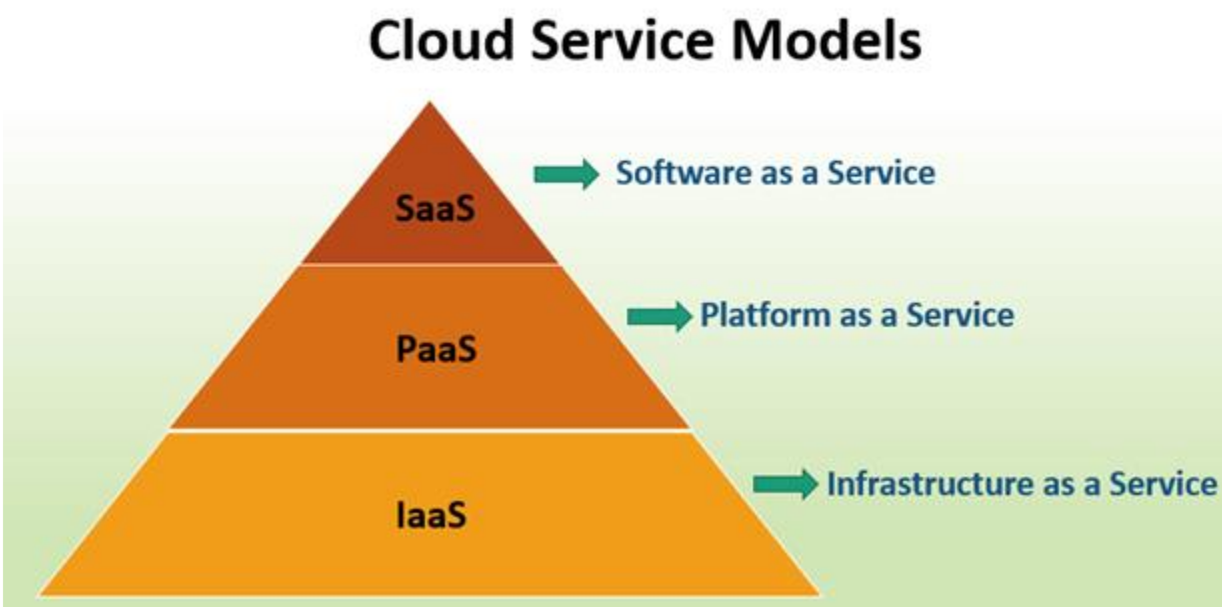

**Figure 2.** Cloud Service Models

## 4. Mobile Cloud Computing

Thanks to developments in networking, wireless technology, and mobile computing, the number of mobile users has increased dramatically, producing enormous amounts of data globally. The need for workplace mobility and the widespread use of sensors in mobile devices have led to the growth of mobile cloud computing, or MCC. In order to handle resource limitations in cellphones, MCC combines wireless networks, cloud computing, and mobile computing to manage and analyze data. Because wireless communication lines are vulnerable, mobile cloud computing (MCC) poses security risks. New privacy-conscious authentication techniques are required to counter this. Cloud computing and mobile devices must be integrated to optimize capabilities and overcome smartphone constraints. It is crucial to comprehend these traits in order to conduct additional study and development [11].

## 5. Architecture for Mobile Cloud Computing

Because of their many uses, mobile devices are becoming more and more commonplace in daily life. However, their designers must contend with resource limitations, such as limited CPU power and storage space. In order to get over these restrictions, Mobile Cloud computer (MCC) makes use of external computer resources. In the MCC architecture, tasks are carried out by mobile devices interacting with networking base stations. Because MCC architectural models include service-oriented architecture (SOA) layers, security considerations are essential. While the internet service layer links the mobile network to the cloud through fast connections, the mobile network layer links mobile users to cloud services through devices like smartphones and tablets [12]. A layer of cloud computing services provided by several service providers is known as the Cloud Services Provider Layer (MCC). It discusses smartphone processor power, storage capacity, battery life, and hardware constraints. MCC is crucial for contemporary mobile computing environments because it addresses hardware constraints and maximizes external computing resources.

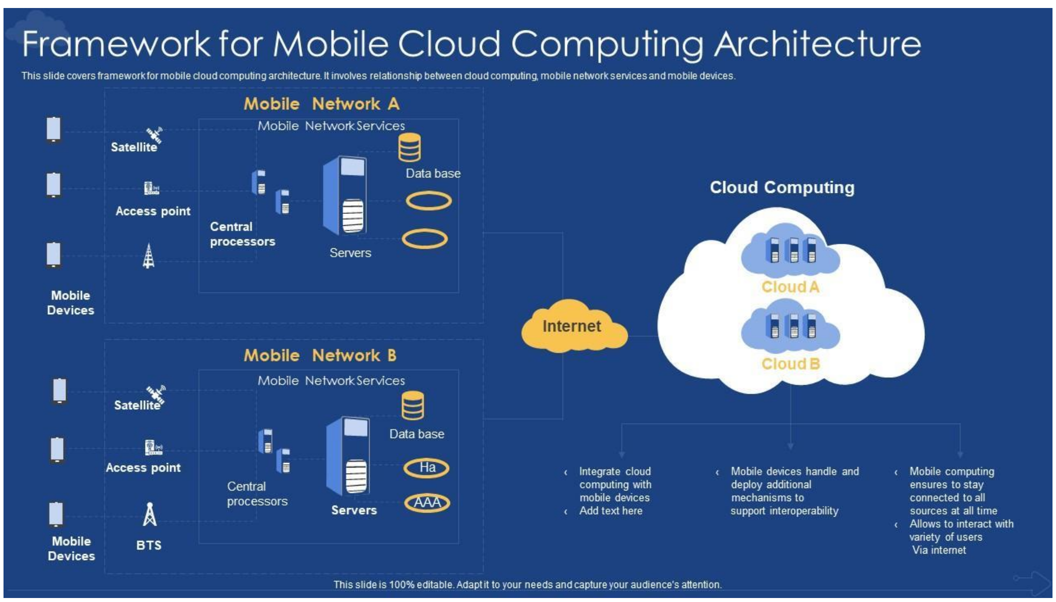


**Figure 3.** Mobile Cloud Computing Architecture

## 6. Mobile Cloud Computing's Advantages

Mobile cloud computing (MCC) is a valuable architecture that provides end users and enterprises with several advantages, such as simplicity of infrastructure construction and maintenance.

*1. Improving Battery Lifetime:* By shifting data processing and storage responsibilities to the cloud, especially for resource-intensive tasks that can rapidly drain the battery when carried out locally, MCC increases device battery life.

*2. Storage:* Cloud storage provides infinite capacity, removing the need to invest in server infrastructure and space issues, and lowering IT expenses related to hardware updates and maintenance for businesses.

*3. Improving Processing Power:* Applications that demand a lot of processing power, such as transcoding, gaming, and multimedia streaming, benefit from MCC's cloud-based processing capabilities.

*4. Disaster Recovery and Backup:* Unlike traditional physical storage solutions, cloud computing providers offer comprehensive backup and recovery services that streamline data backup and *restoration procedures and improve disaster recovery capabilities.*

*5. Scalability:* By allowing for scalability across web, cloud, and mobile devices, mobile apps can adjust to shifting user needs and meet different usage patterns.

*6. Reliability:* Cloud infrastructure outperforms individual devices in terms of security features like virus detection and authentication, guaranteeing the dependability and safety of cloud-based apps.

Beyond individual users, mobile cloud computing has a host of advantages for enterprises, such as improved performance, scalability, security, and dependability [13-30].

## 7. Actual life uses for mobile cloud computing services that are dispersed.

In order to increase speed, prolong battery life, and provide scalable, real-time services, distributed mobile cloud computing, or DMCC, combines mobile devices with cloud computing infrastructure. Distributed mobile cloud computing services have several practical uses, such as:

### 1. Smart Cities

• Traffic Management: By combining data from dispersed mobile devices, including smartphones, sensors, and cameras, DMCC assists in real-time traffic pattern analysis, improving traffic flow, and easing congestion.

• Environmental Monitoring: Temperature, noise levels, and air quality are measured by dispersed mobile sensors, which then process and analyze the data in the cloud. This enhances public health and encourages responsible environmental management.

### 2. Medical Care and Telemedicine

• Remote Monitoring: To provide ongoing health monitoring and prompt interventions, wearable technology and smartphone apps gather health data, including heart rate and blood sugar levels, which is then processed in the cloud.

• Medical Image Processing: Distributed clouds can process large medical pictures, such CT and MRI scans, giving clinician's remote access to improved diagnostic tools.

**3. Augmented Reality (AR) and Virtual Reality (VR)**

• Gaming and Entertainment: By shifting processing from mobile devices to cloud servers, DMCC enables resource-intensive AR/VR apps, providing immersive experiences while lowering latency and preserving responsiveness.

• Education and Training: To scale and provide low-latency experiences on mobile devices, AR/VR apps for remote learning and simulation-based training make use of distributed cloud computing.

**4. Social Networks on the Go**

• Content Sharing: Distributed mobile cloud computing eases the load on individual devices by processing and storing large volumes of images, videos, and other content in social media apps, allowing for rapid access to the media.

• Personalized Content Delivery: By analyzing user behavior and preferences, cloud services improve user experience by instantly delivering personalized content to mobile users.

**5. IoT and Edge Computing**

• Smart Homes: By shifting data processing to cloud infrastructure, distributed mobile clouds improve automation and efficiency by enabling real-time control of IoT devices (such as smart lights, thermostats, and security systems) through mobile apps.

• Industrial IoT (IIoT): DMCC analyzes data from dispersed sensors in manufacturing facilities to provide predictive maintenance and real-time monitoring, minimizing downtime and enhancing operational effectiveness.

**6. MVNOs, or mobile virtual network operators**

• Flexible Network Management: By using DMCC services to flexibly distribute network resources, MVNOs can provide scalable and reasonably priced mobile communication services in response to real-time demand, thereby enhancing user service quality.

**7. Mobile Apps for Collaboration**

• Crowdsourcing Platforms: Distributed mobile cloud computing is used by mobile apps that rely on user-generated content, like Waze (traffic data) or OpenStreetMap, to process and integrate data from multiple mobile devices and provide users with accurate and timely information.

• Distributed Computing Projects: Apps such as SETI@home work with cloud services to do distributed computing tasks for research objectives by utilizing the idle processing power of mobile devices.

**8. Mobile Cloud Gaming**

• Game Streaming: By shifting processing and graphics rendering to robust cloud servers, DMCC allows cloud gaming platforms such as Google Stadia or Xbox Cloud Gaming to stream top-notch games to mobile devices while maintaining a fluid gameplay experience with low latency.

**9. Retail and E-Commerce**

• Mobile Payment Systems: By processing transactions in the cloud while upholding high security and low latency replies, DMCC guarantees the security and scalability of mobile payment apps (such as Apple Pay and Google Pay).

• Inventory Management: By processing and analyzing data in the cloud, retailers may optimize supply chain management and stock levels while managing inventory in real time across numerous stores using distributed mobile cloud computing.
These uses demonstrate how DMCC aids in resolving issues with scalability, throughput, and real-time data processing in a variety of sectors.

**1. The potential applications of dispersed mobile cloud computing services.**
A model known as Distributed Mobile Cloud Computing (DMCC) makes use of cloud computing resources dispersed among numerous mobile devices and edge servers. As it improves computing efficiency, latency, and resource usage by bridging the gap between cloud services and mobile devices, its potential is enormous. The following are some crucial areas for possible development:
1. Integration of 5G and Edge Computing
• Applications with Low Latency: By lowering latency and processing data closer to the edge, DMCC in conjunction with 5G networks makes real-time applications possible, such as driverless vehicles, virtual reality, and augmented reality.
• Decentralized AI: More individualized and contextually aware AI systems can be produced by training and running AI models on dispersed devices.

**2. Smart Cities and IoT**
• Real-Time Data Processing: DMCC will enable local data processing by Internet of Things (IoT) devices in smart cities, as well as the sharing of pertinent data with the cloud for more comprehensive analytics. Better trash management, energy saving, and traffic systems will result from this.
• Improved Scalability: As the number of connected devices increases, distributed mobile clouds will enable the smart city infrastructure's quick scalability, enabling more effective resource management.

**3. Efficiency in Energy Use**
• Resource Optimization: By shifting computation-intensive jobs to dispersed clouds, mobile devices' energy usage can be optimized. The requirement for high-power computation on individual devices is decreased when workload is distributed evenly among devices, increasing overall system efficiency.
• Green Cloud Computing: By leveraging local computing resources, distributed mobile cloud computing can result in more energy-efficient systems by lowering data transit and, consequently, energy consumption in comparison to centralized cloud models.

**4. Wearable technology and healthcare**
• Telemedicine: By processing patient data from wearables and mobile sensors in real-time, mobile cloud computing may be essential to telemedicine, allowing for remote monitoring and quicker diagnosis.
• Distributed Health Data Management: By using edge computing to protect patient privacy, DMCC may enable distributed health records management, guaranteeing quicker access to patient data.
5. Security and Privacy of Data

• Decentralized Data Control: By integrating blockchain technology, DMCC can enhance data security and privacy by enabling decentralized data storage and access control systems, particularly in delicate industries like healthcare and finance.
• Distributed Security Models: By lowering single points of failure, security procedures can be dispersed among nodes, increasing resistance to cyberattacks.

**6. Virtual and Augmented Reality**
• Real-Time Processing: By utilizing distributed mobile and edge resources, DMCC will make it possible for AR and VR apps to process data in real time. As a result, applications for leisure, education, and gaming will run more smoothly.
• Less Network Congestion: By shifting AR/VR data processing to the dispersed mobile cloud, centralized servers will be less taxed, allowing for quicker and more scalable content delivery.

**7. Autonomous Systems**
• Drones and Autonomous Vehicles: By processing data on edge nodes and neighboring devices, distributed mobile cloud services may allow autonomous systems, such as drones and self-driving automobiles, to make decisions more quickly.
• Collaborative Learning: Distributed learning models, in which drones and cars share real-time information, can help autonomous systems by eliminating the requirement for all processing to take place in central cloud data centers.

**8. Gaming and Entertainment**
• Cloud Gaming: With DMCC guaranteeing quicker reaction times, reduced latency, and improved user experiences, there will be a rise in demand for cloud gaming services. Workloads related to gaming could be transferred from mobile devices to dispersed cloud nodes.
• Streaming Services: By shifting processing duties to the edge, lowering latency, and delivering high-quality video, DMCC will maximize video streaming, particularly in areas with inadequate internet access.

**9. Business and Enterprise Applications**
• Mobile Enterprise Solutions: Companies will use DMCC more and more for remote and mobile workforce management, giving workers safe, effective access to cloud resources from any location.
• Distributed Workflows: By distributing cloud services over several servers and mobile devices, enterprises can manage intricate workflows more effectively, increasing output and decreasing downtime.

**10. Environmental Monitoring**
Distributed Sensor Networks: Using IoT sensors dispersed throughout various places, mobile cloud computing may be utilized to monitor environmental variables in real time, such as water levels and air quality. Faster decision-making in disaster relief and climate change monitoring will be made possible by this [47].

**11. Decentralized Finance (DeFi) and Blockchain**

• Mobile Blockchain Nodes: By enabling mobile devices to function as nodes in a decentralized network, DMCC might facilitate blockchain applications by facilitating data sharing, smart contracts, and quicker and more secure financial transactions.

• Distributed Ledger Technology: By combining DMCC with distributed ledger technology, government operations, healthcare data, and financial institutions may become more transparent and secure.

**12. Social Networks of the Next Generation**

• Localized Content Sharing: By facilitating localized data processing and content sharing, improving privacy, and lessening the strain on centralized servers, DMCC can aid in the development of next-generation social networking platforms.

• Context-Aware Communication: By using DMCC, social networks can provide notifications and material in a way that is more contextually aware of the user's current surroundings and device capabilities [43][44].

Because of the increasing reliance on mobile devices, edge computing, the Internet of Things, and cloud infrastructure, distributed mobile cloud computing has a bright future with enormous potential across numerous industries. This paradigm, which offers improved performance, scalability, and sustainability, will influence technology in the future [45] [46].


**Figure 4.** Future of Cloud Computing

## 9. Conversation

Applications and data are integrated across regional borders by cloud computing, and distributed cloud computing makes collaborative workflows possible. No matter where they are, users can access computational resources using mobile cloud computing, facilitating sophisticated data processing and rich multimedia experiences. The combination of cloud and mobile technology spurs innovation across sectors and breaks down conventional barriers.

In cloud computing and mobile technology, load balancing is essential for maximizing efficiency and resource use. It optimizes power usage, increasing efficiency and prolonging the life of mobile devices. Modern computing paradigms are centered on the pursuit of scalability, with distributed and mobile cloud computing spearheading the movement toward adaptable computation and a more robust digital infrastructure [31-40].

Numerous advantages of distributed and mobile cloud computing include changing user interactions, spurring innovation in a variety of fields, and quickening the convergence of mobile and cloud technology [41][42].

Table (1): Summary of Distributed Cloud Computing.

| **Feature** | (Z. A. S. A. et al Najat Z, 2019) | (Miguel Castanheira Sanches, n.d.) | (Salem, n.d.) |
|---|---|---|---|
| process a batch or a stream of data | | ✓ | |
| support scalability | | ✓ | |
| reduced latency times | ✓ | ✓ | |
| achieve high performance | | | |
| high resource utilization | | | |
| performing huge processing | ✓ | | ✓ |
| utilizing power via cloud domain | ✓ | ✓ | |
| reduce a huge amount of processing power | ✓ | ✓ | ✓ |

Table (2). Summary of Mobile Cloud Computing

| **Feature** | (He et al., 2018) | (Z. A. S. A. et al Najat Z, 2019) | (Borcea et al., n.d.) | (Salem, n.d.) | (Mishra et al., n.d.) |
|---|---|---|---|---|---|
| solve a long-standing problem | | | ✓ | | |
| identity-based signature scheme | ✓ | | | | |
| less computation time | ✓ | | | | |
| Fewer communication costs | ✓ | | | | |
| parallel computations | ✓ | ✓ | | | |
| better performance | ✓ | ✓ | | | |
| power saving | | ✓ | | | |
| Improve performance | | ✓ | | ✓ | |
| Huge Computation saving | | | | ✓ | |
| Increasing Scalability | | | | | ✓ |

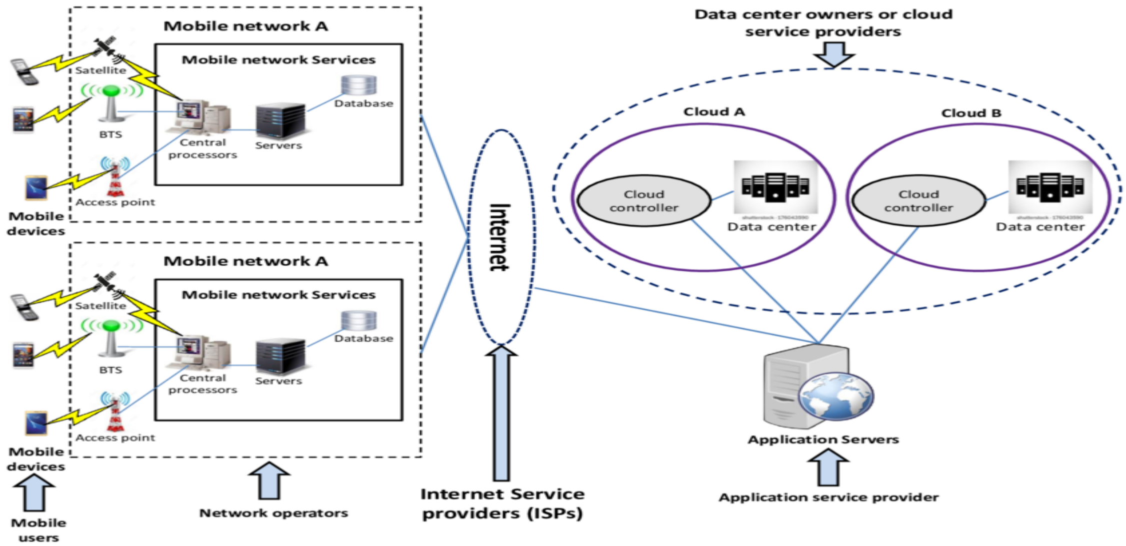


**Figure 5. A**n architecture for distributed mobile cloud computing

## 10. Conclusion

A careful examination of the details and comparison graphs in Section 6 makes it evident that mobile cloud computing and distributed cloud computing both have unique advantages and applications. Lowering latency times, offering high processing capacities, effectively using cloud electricity, and reducing major processing power requirements have been the main goals of previous distributed cloud computing research projects. Even though researchers have made great strides in enhancing data processing streams and facilitating scalability, there is still a gap in achieving optimal performance and resource consumption. However, mobile cloud computing, which prioritizes parallel processing and enhanced system efficiency, has emerged as a brilliant example of innovation. These advancements have solved long-standing problems such as identity-based signature systems, decreasing communication and calculation times, saving a significant amount of computation under high loads, and enhancing scalability. This study focuses on the area of mobile cloud computing, which the integration of cloud is computing into a mobile environment to enable users to access resources whenever they need them. Security protocols that are intended to prevent unauthorized access to sensitive data and information kept in the cloud are the main issues with mobile cloud computing. As we outline our future research plans, security concerns must be carefully taken into account while developing mobile cloud solutions. By addressing these security issues head-on, we can build a more robust and resilient mobile cloud ecosystem that meets users' evolving needs while upholding the highest standards of data privacy and security.

In essence, despite offering distinct advantages and areas of focus, distributed cloud computing and mobile cloud computing both demonstrate the transformative potential of cloud technology in revolutionizing the digital world. As we navigate the complexities of a world that is becoming more interconnected, it is crucial to take advantage of the synergies between dispersed and mobile cloud computing. Customers will have unparalleled access to computing resources as a result, and cooperation and creativity will be encouraged. We can fully fulfill the potential of mobile cloud computing and usher in a new era of digital empowerment and excellence by utilizing thorough research and strategically placed investments in security and performance enhancement.

## References


1. Asghari, A., & Sohrabi, M. K. (2024). Server placement in mobile cloud computing: A comprehensive survey for edge computing, fog computing and cloudlet. Computer Science Review, 51, 100616.
2. Afek, Y., Giladi, G., & Patt-Shamir, B. (2024). Distributed computing with the cloud. Distributed Computing, 37(1), 1-18.
3. Zangana, H. M., & Zeebaree, S. R. (2024). Distributed Systems for Artificial Intelligence in Cloud Computing: A Review of AI-Powered Applications and Services. International Journal of Informatics, Information System and Computer Engineering (INJIISCOM), 5(1), 11-30.
4. Bi, C., Li, J., Feng, Q., Lin, C. C., & Su, W. C. (2024). Optimal deployment of vehicular cloud computing systems with remote microclouds. Wireless Networks, 30(6), 5305-5317.
5. Mir, A. A. (2024). Optimizing Mobile Cloud Computing Architectures for Real-Time Big Data Analytics in Healthcare Applications: Enhancing Patient Outcomes through Scalable and Efficient Processing Models. Integrated Journal of Science and Technology, 1(7).
6. Kanwal, A., Amjad, T., & Ashraf, H. (2024). Framework for Agent-Based Multistage Application Partitioning Algorithm in Mobile Cloud Computing. SN Computer Science, 5(4), 330.
7. Khalaf, O. I., Anand, D., Abdulsahib, G. M., & Chandra, G. R. (2024). Original Research Article A coherent salp swarm optimization based deep reinforced neuralnet work algorithm for securing the mobile cloud systems. Journal of Autonomous Intelligence, 7(3).
8. Khalaf, O. I., Anand, D., Abdulsahib, G. M., & Chandra, G. R. (2024). Original Research Article A coherent salp swarm optimization based deep reinforced neuralnet work algorithm for securing the mobile cloud systems. Journal of Autonomous Intelligence, 7(3).
9. Dhanasekaran, S., Rajput, K., Yuvaraj, N., Aeri, M., Shukla, R. P., & Singh, S. K. (2024, May). Utilizing Cloud Computing for Distributed Training of Deep Learning Models. In 2024 Second International Conference on Data Science and Information System (ICDSIS) (pp. 1-6). IEEE.
10. Pramanik, P. K. D., Pal, S., & Choudhury, P. (2024). Mobile crowd computing: potential, architecture, requirements, challenges, and applications. The Journal of Supercomputing, 80(2), 2223-2318.
11. William, D., & Bommu, R. (2024). Harnessing AI and Machine Learning in Cloud Computing for Enhanced Healthcare IT Solutions. Unique Endeavor in Business & Social Sciences, 3(1), 70-84.
12. Raghav, Y. Y., & Kait, R. (2024). Edge computing empowering distributed computing at the edge. In Emerging Trends in Cloud Computing Analytics, Scalability, and Service Models (pp. 67-83). IGI Global.
13. Mahesar, A. R., Li, X., & Sajnani, D. K. (2024). Efficient microservices offloading for cost optimization in diverse MEC cloud networks. Journal of Big Data, 11(1), 123.
14. Anandappa, M., & Mudnal, M. K. (2024). Cloud computing and security issues in the cloud. Journal of Scientific Research and Technology, 59-66.
15. Rajagopalan, A., Swaminathan, D., Bajaj, M., Damaj, I., Rathore, R. S., Singh, A. R., ... & Prokop, L. (2024). Empowering power distribution: Unleashing the synergy of IoT and cloud computing for sustainable and efficient energy systems. Results in Engineering, 101949.
16. Asghari, A., & Sohrabi, M. K. (2024). Server placement in mobile cloud computing: A comprehensive survey for edge computing, fog computing and cloudlet. Computer Science Review, 51, 100616.
17. Zeebaree, I. (2024). The Distributed Machine Learning in Cloud Computing and Web Technology: A Review of Scalability and Efficiency. Journal of Information Technology and Informatics, 3(1).
18. Yadav, S. K., & Kumar, R. (2024). ASME-SKYR framework: A comprehensive task scheduling framework for mobile cloud computing. Wireless Networks, 30(3), 1221-1244.
19. Zangana, H. M., & Zeebaree, S. R. (2024). Distributed Systems for Artificial Intelligence in Cloud Computing: A Review of AI-Powered Applications and Services. International Journal of Informatics, Information System and Computer Engineering (INJIISCOM), 5(1), 11-30.
20. Dhinakaran, D., Selvaraj, D., Dharini, N., Raja, S. E., & Priya, C. (2024). Towards a novel privacy-preserving distributed multiparty data outsourcing scheme for cloud computing with quantum key distribution. arXiv preprint arXiv:2407.18923.
21. Hassan, M. U., Al-Awady, A. A., Ali, A., Iqbal, M. M., Akram, M., & Jamil, H. (2024). Smart Resource Allocation in Mobile Cloud Next-Generation Network (NGN) Orchestration with Context-Aware Data and Machine Learning for the Cost Optimization of Microservice Applications. Sensors, 24(3), 865.

22. Khalaf, O. I., Anand, D., Abdulsahib, G. M., & Chandra, G. R. (2024). Original Research Article A coherent salp swarm optimization based deep reinforced neuralnet work algorithm for securing the mobile cloud systems. Journal of Autonomous Intelligence, 7(3).
23. Mondal, R. (2024). Mobile Cloud Computing. In Emerging Trends in Cloud Computing Analytics, Scalability, and Service Models (pp. 170-185). IGI Global.
24. Alabdeli, H., Yamsani, N., Anitha, D., Chaithra, K. N., & Bindu, G. (2024, February). Intrusion Detection System in Mobile Cloud Computing Using Bat Optimization Algorithm-Support Vector Machine. In 2024 International Conference on Integrated Circuits and Communication Systems (ICICACS) (pp. 1-4). IEEE.
25. Pramanik, P. K. D., Pal, S., & Choudhury, P. (2024). Mobile crowd computing: potential, architecture, requirements, challenges, and applications. The Journal of Supercomputing, 80(2), 2223-2318.
26. Vellela, S. S., & Balamanigandan, R. (2024). Optimized clustering routing framework to maintain the optimal energy status in the wsn mobile cloud environment. Multimedia Tools and Applications, 83(3), 7919-7938.
27. Fadhil, J., & Zeebaree, S. R. (2024). Blockchain for Distributed Systems Security in Cloud Computing: A Review of Applications and Challenges. Indonesian Journal of Computer Science, 13(2).
28. Fadhil, J., & Zeebaree, S. R. (2024). Blockchain for Distributed Systems Security in Cloud Computing: A Review of Applications and Challenges. Indonesian Journal of Computer Science, 13(2).
29. Anandappa, M., & Mudnal, M. K. (2024). Cloud computing and security issues in the cloud. Journal of Scientific Research and Technology, 59-66.
30. Taher, H., & Zeebaree, S. R. (2024). Harnessing the Power of Distributed Systems for Scalable Cloud Computing A Review of Advances and Challenges. Indonesian Journal of Computer Science, 13(2).
31. Khan, S., Jiangbin, Z., Irfan, M., Ullah, F., & Khan, S. (2024). An expert system for hybrid edge to cloud computational offloading in heterogeneous MEC–MCC environments. Journal of Network and Computer Applications, 225, 103867.
32. Verma, G. (2024). Blockchain-based privacy preservation framework for healthcare data in cloud environment. Journal of Experimental & Theoretical Artificial Intelligence, 36(1), 147-160.
33. Kumar, A., Boreda, D., & Vishwakarma, S. (2024, April). Redesigned Cloud Service Migration Techniques for Improved Portability. In 2024 IEEE 13th International Conference on Communication Systems and Network Technologies (CSNT) (pp. 550-554). IEEE.
34. Soni, P. K., & Dhurwe, H. (2024). Challenges and Open Issues in Cloud Computing Services. In Advanced Computing Techniques for Optimization in Cloud (pp. 19-37). Chapman and Hall/CRC.
35. Murad, S. A., Azmi, Z. R. M., Muzahid, A. J. M., Sarker, M. M. H., Miah, M. S. U., Bhuiyan, M. K. B., ... & Bairagi, A. K. (2024). Priority based job scheduling technique that utilizes gaps to increase the efficiency of job distribution in cloud computing. Sustainable Computing: Informatics and Systems, 41, 100942.
36. Merseedi, K. J., & Zeebaree, S. R. (2024). The cloud architectures for distributed multi-cloud computing: a review of hybrid and federated cloud environment. Indonesian Journal of Computer Science, 13(2).
37. Jiang, Q., Xu, X., Bilal, M., Crowcroft, J., Liu, Q., Dou, W., & Jiang, J. (2024). Potential game based distributed IoV service offloading with graph attention networks in mobile edge computing. IEEE Transactions on Intelligent Transportation Systems.
38. Sinha, A., Banerjee, P., Roy, S., Rathore, N., Singh, N. P., Uddin, M., ... & Alsaqour, R. (2024). Improved Dynamic Johnson Sequencing Algorithm (DJS) in Cloud Computing Environment for Efficient Resource Scheduling for Distributed Overloading. Journal of Systems Science and Systems Engineering, 1-34.
39. Wang, Y., Yang, C., Lan, S., Zhu, L., & Zhang, Y. (2024). End-edge-cloud collaborative computing for deep learning: A comprehensive survey. IEEE Communications Surveys & Tutorials.
40. Kaur, S. (2024). Novel Encryption Technique for Cloud Computing Access Control. In Advancing Sustainable Science and Technology for a Resilient Future (pp. 323-326). CRC Press.
41. Larhgotra, A., Kumar, R., & Gupta, M. (2022, November). Traffic monitoring and management system for congestion comtrol using iot and ai. In *2022 Seventh International Conference on Parallel, Distributed and Grid Computing (PDGC)* (pp. 641-646). IEEE.
42. Kumar, R., Gupta, M., & Sapra, S. R. (2021, October). Speech to text community application using natural language processing. In *2021 5th International Conference on Information Systems and Computer Networks (ISCON)* (pp. 1-6). IEEE.
43. Sharma, P., Kumar, R., Gupta, M., & Nayyar, A. (2024). A critical analysis of road network extraction using remote sensing images with deep learning. *Spatial Information Research*, 1-11.
44. Rao, H., Gupta, M., Agarwal, P., Bhatia, S., & Bhardwaj, R. (2024). Mental health issues assessment using tools during COVID-19 pandemic. *Innovations in Systems and Software Engineering*, *20*(3), 393-404.

45. Agarwal, S., & Chander Prabha, D. M. G. (2021). Chronic diseases prediction using machine learning–A review. *Annals of the Romanian Society for Cell Biology*, 3495-3511.
46. Gupta, M., Kumar, R., Chawla, S., Mishra, S., & Dhiman, S. (2021). Clustering based contact tracing analysis and prediction of SARS-CoV-2 infections. *EAI Endorsed Transactions on Scalable Information Systems*, *9*(35).
47. Kour, S., Kumar, R., & Gupta, M. (2021, October). Study on detection of breast cancer using Machine Learning. In *2021 International Conference in Advances in Power, Signal, and Information Technology (APSIT)* (pp. 1-9). IEEE.