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## **Cloud Computing and IoT**

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# QUESTION PAPER

June – 2023

(Solved)

## CLOUD COMPUTING AND IOT

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Time: 3 Hours ]

[ Maximum Marks : 100  
Weightage: 70%

Note: Question No. 1 is compulsory. Attempt any three questions from the rest.

Q. 1. (a) What is cloud computing service delivery models? List and explain any four service delivery models.

Ans. Ref.: See Chapter-2, Page No. 12, 'Cloud Service Delivery Models'.

(b) Explain the following scaling strategies:

(i) Proactive scaling

(ii) Reactive scaling

(iii) Combinational scaling

Also, compare proactive and reactive scaling with reference to the suitability, working, cost and implementation parameters.

Ans. Ref.: See Chapter-5, Page No. 50, 'Scaling Strategies', Page No. 54, Q. No. 2, Q. No. 3 and Page No. 58, Q. No. 8.

(c) Explain all the four components, which support IoT system, with the help of a sample block diagram.

Ans. Ref.: See Chapter-9, Page No. 102, Q. No. 3.

(d) What is fog computing? Explain the working of its along with any use case. Also, mention its advantages.

Ans. Ref.: See Chapter-11, Page No. 125, 'Introduction to Fog Computing' and Page No. 126, 'Working of Fog'.

Q. 2. (a) Define edge computing. Also, briefly explain the working of edge computing.

Ans. Ref.: See Chapter-11, Page No. 127, 'Edge Computing' and 'Working of Edge Computing'.

(b) What is Virtualization? Explain its underlying abstraction. Also, mention its important characteristics.

Ans. Ref.: See Chapter-3, Page No. 26, 'Virtualization and Underlying Abstraction'.

Q. 3. (a) Compare and contrast cluster, grid and cloud computing with reference to characteristics, physical structure, hardware, resources, applications, networking and scalability parameters.

Ans. Ref.: See Chapter-1, Page No. 5, Q. No. 3.

(b) What is load balancing? What is its functionality? Explain the following load-balancers along with their features:

(i) Network load balancer

(ii) Application load balancer

Ans. Ref.: See Chapter-6, Page No. 64, Q. No. 1 and Page No. 65, Q. No. 3 and Q. No. 4.

Q. 4. (a) Define a sensor with reference to an IoT device. Explain its characteristics. List and explain any four IoT sensors along with their functions in the IoT devices.

Ans. Ref.: See Chapter-8, Page No. 88, 'Sensors'.

(b) What is cloud security? What are the threats to cloud security? Explain various information security methods in cloud computing.

Ans. Ref.: See Chapter-7, Page No. 71, 'Cloud Security', Page No. 72, 'Security Issues in Cloud Service Delivery Models', Page No. 74, 'Security Issues in Cloud Deployment Models' and Page No. 75, 'Ensuring Security in Cloud Against Various Types of Attacks'.

Q. 5. Write short notes on the following:

(a) Public and private clouds

Ans. Ref.: See Chapter-2, Page No. 15, Q. No. 2.

(b) Challenges in cloud computing

Ans. Ref.: See Chapter-7, Page No. 81, Q. No. 4.

(c) Hierarchical structure of cloud

Ans. Ref.: See Chapter-2, Page No. 21, Q. No. 8.

(d) Use case of edge computing

Ans. Ref.: See Chapter-11, Page No. 131, Q. No. 8.



# QUESTION PAPER

December– 2022

(Solved)

## CLOUD COMPUTING AND IOT

M.C.S.-227

Time: 3 Hours ]

[ Maximum Marks : 100  
Weightage: 70%

Note: Question No. 1 is compulsory. Attempt any three questions from the rest.

Q. 1. (a) What is resource provisioning in cloud computing ? Explain the static and dynamic approaches of resource provisioning. Mention their advantages and disadvantages.

Ans. Ref.: See Chapter-4, Page No. 40, 'Resource Provisioning and Approaches'.

(b) Define Load Balancing. Explain the following algorithms with reference to load balancing:

- (i) Static Algorithm Approach
- (ii) Weighted Round Robin

Ans. Ref.: See Chapter-6, Page No. 62, 'What is Load Balancing?', Page No. 63, 'Static Algorithm Approach' and Page No. 64, 'Weighted Round Robin Load Balancing Algorithm'.

(c) Discuss the following baseline technologies of IoT:

- (i) Security in IoT
- (ii) IoT Analytics
- (iii) IoT Processors
- (iv) IoT Standards and Ecosystems

Ans. Ref.: See Chapter-8, Page No. 88, 'Baseline Technologies of IoT'.

(d) Define Edge Computing. Draw a block diagram of Cloud-Fog-Edge collaboration and explain all its layers.

Ans. Ref.: See Chapter-11, Page No. 131, Q. No. 6 and Q. No. 7.

Q. 2. (a) What is scalability in Cloud Computing? Explain the following strategies of scaling:

- (i) Proactive Scaling
- (ii) Reactive Scaling

Ans. Ref.: See Chapter-5, Page No. 49, 'Introduction' and Page No. 50, 'Scaling Strategies'.

(b) Define VM (Virtual Machine) sizing. Discuss the two ways to do VM sizing.

Ans. Ref.: See Chapter-4, Page No. 46, Q. No. 8.

(c) Mention any five applications of Cloud Computing.

Ans. Ref.: See Chapter-1, Page No. 8, Q. No. 7.

Q. 3. (a) Define a sensor with reference to an IoT device. Explain various characteristics of sensors. Also, mention and explain any four classifications of sensors.

Ans. Ref.: See Chapter-8, Page No. 88, 'Sensors'.

(b) Explain the following computing components used in laboratories of IoT/Cloud:

- (i) Arduino
- (ii) Raspberry Pi

Ans. Ref.: See Chapter-8, Page No. 89, 'Computing Components (Arduino, Raspberry Pi)'.

Q. 4. (a) Discuss the following Service Delivery Models of Cloud, with an example for each:

- (i) Platform as a Service (PaaS)
- (ii) Infrastructure as a Service (IaaS)

Ans. Ref.: See Chapter-2, Page No. 19, Q. No. 6 (a and b).

(b) "Cloud Computing offers a variety of deployment models, a network connection viewpoint will be used to examine Cloud deployment models and their accessible components." With reference to this statement, discuss the following types of network connectivities:

- (i) Public Inter Cloud Networking
- (ii) Private Intra Cloud Networking

Ans. Ref.: See Chapter-2, Page No. 11, 'Cloud Deployment Models', Page No. 12, 'Choosing

# **Sample Preview of The Chapter**

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# CLOUD COMPUTING AND IoT

## Cloud Computing: An Introduction

1

### INTRODUCTION

Cloud computing is a way of delivering computing services including – servers, storage, databases, networking, software, analytics, and intelligence over the internet. This enables faster innovation, flexible resources, and economies of scale. You only pay for the cloud services you use, which helps you lower your operating costs, run your infrastructure more efficiently, and scale as your business needs change. It represents a significant departure from the traditional way businesses think about IT resources. However, not all clouds are the same, and there is no single type of cloud computing that is right for everyone. Different models, types, and services have evolved to help provide the right solution for your needs.

### CHAPTER AT A GLANCE

#### **TRADITIONAL COMPUTING APPROACHES**

Previously, computing power was expensive and scarce, but the advent of cloud computing has transformed it into an abundant and cost-effective resource. This shift marks a transition from scarcity computing to abundance computing, revolutionising the Information and Communications Technology (ICT) industry. Cloud computing is akin to utilities like water and electricity, offering on-demand IT services with pay-as-you-go billing. It enhances technological partnerships, streamlines marketing, improves security, and enhances the stakeholder and consumer experience while reducing costs. With cloud computing, resource provisioning matches actual needs, enabling instant scalability. This paradigm has given rise to distributed computing forms like grid computing and cloud computing. Applications

demanding high-performance computing, such as scientific and engineering simulations, complex system modelling, and internet-based services, prompted the development of cost-effective solutions like clusters, grids, and cloud computing. Dedicated parallel computers were expensive and lacked scalability, leading to the creation of these accessible and extensible computing models.

#### **EVOLUTION OF CLOUD COMPUTING**

The modern era has witnessed a tremendous surge in computing power and networking capabilities. Clusters of workstations are now interconnected with impressive latencies and bandwidth, rivalling tightly coupled machines. The concept of clusters gained momentum in the 1990s, with “grid computing” also emerging as a metaphor for making computer power as accessible as electric power grids. Grids represented an innovative extension of distributed computing technology. However, the evolution of cloud computing, which includes phases like Grid Computing, Utility Computing, Application Service Provision, and Software as a Service, has been a remarkable journey. The origin of computing resources provision via a global network dates back to the 1960s, but cloud computing’s history is relatively recent. The first business and consumer cloud computing websites, such as Salesforce.com and Google, were launched in 1999. Cloud computing’s development is closely linked to Internet evolution and its impact on corporate technology. It has a rich history intertwined with the growth of computers as real business solutions. Key milestones in the history of cloud computing include computer scientist John McCarthy’s time-sharing concept, J.C.R. Licklider’s vision of a global computer network, the use of virtualization tools like VMware, and the launch of services like Salesforce.com in 1999.



In 2006, Amazon's cloud services, including Elastic Compute Cloud (EC2) and Simple Storage Service (S3), marked a significant turning point, establishing cloud computing as a standard model for both users and the industry as a whole. Cloud computing has become one of the most groundbreaking technologies of our time, transforming the way we access and utilize computing resources.

### COMPARISON BETWEEN CLUSTER, GRID AND CLOUD COMPUTING

Cluster, grid, and cloud computing are distinct paradigms that leverage networks of interconnected computers but differ in key aspects. Clusters involve a group of machines working collaboratively, typically used for high-performance computing. Grid computing extends this idea to a broader network, sharing resources on a global scale. It's often used for complex scientific simulations. Cloud computing, on the other hand, provides on-demand access to a pool of computing resources via the internet, emphasizing scalability, cost-efficiency, and ease of access. Cloud computing focuses on delivering services rather than managing infrastructure, making it an accessible choice for a wide range of applications and users.

### UTILITY COMPUTING

Utility computing encompasses technologies and business models offered by service providers to IT customers, who are billed based on consumption. Services include storage, computing power, and applications, following the utility model akin to water, electricity, and gas services provided by utility companies. In utility computing, clients are charged according to their measured usage, similar to virtualization but offering greater computing power through shared networks.

Distributed computing involves performing a single computation on multiple web servers. Service providers own the storage or power resources, and customers are charged based on their utilization. This model, often referred to as Infrastructure as a Service (IaaS) or Hardware as a Service (HaaS), aligns with basic utility services, where you pay for what you consume.

Utility computing offers flexibility because you don't own or lease resources long-term, enabling you to adjust computing power swiftly to meet your business needs. Whether you're a major corporation or an individual, utility computing allows you to adapt your service capacity in seconds, paying for what you

use, be it per second or per hour. This adaptability is a valuable feature, making it a cost-effective and convenient solution.

### CHARACTERISTICS OF CLOUD COMPUTING

Cloud computing offers several key features:

**On-demand Self Service:** Users can access services without manual intervention, making it convenient and efficient.

**Broad Network Access:** Cloud resources are accessible from any location and device, providing flexibility for users.

**Resource Pooling:** Multiple customers share physical resources such as storage, memory, and virtual machines, optimizing resource utilization.

**Measured Services:** Users pay based on their actual service usage, ensuring cost efficiency.

**Rapid Elasticity and Scalability:** Cloud platforms allow swift resource provisioning and removal, aligning with dynamic business needs.

**Easy Maintenance:** Cloud infrastructure maintenance is simplified, reducing administrative burdens.

**Enhanced Security:** Data redundancy across multiple servers ensures data safety even in case of hardware failures.

These features collectively make cloud computing a versatile, cost-effective, and secure solution for various business requirements.

### BENEFITS OF CLOUD COMPUTING

Cloud computing benefits include universal resource access, on-demand self-service, cost reduction by eliminating hardware and maintenance expenses, easy scalability, online development tools, global collaboration, secure data storage across multiple locations, device independence, and time savings through automated software updates and hardware maintenance.

### APPLICATIONS OF CLOUD COMPUTING

Cloud computing offers a range of services that benefit organizations in various fields. These services include online data storage, backup and recovery, big data analysis, e-commerce applications, education, e-governance, medical fields and entertainment.

Online data storage is a major benefit provided by cloud computing. It allows organizations to store data such as files, images, audios, and videos on the cloud, eliminating the need for physical storage systems. This saves organizations a huge amount of money, especially as data generation continues to grow. Cloud storage also allows for easy access to data whenever needed.

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Cloud vendors provide backup and recovery services to ensure the safety of data. They offer various recovery applications to retrieve lost data. This is a major advantage over traditional backup methods, which can be complex and difficult to recover data from.

Big data analysis is another significant benefit of cloud computing. With the volume of data generated by organizations continuing to grow, traditional data management systems are no longer viable options. Cloud computing allows organizations to store large volumes of data in the cloud, and provides high-quality tools for data analytics to extract insights and useful information.

Cloud-based e-commerce applications enable organizations to respond quickly to market opportunities. This is achieved by managing customer data, product data, and other operational systems in cloud environments.

Cloud computing has also revolutionized education through e-learning, distance learning, and student portals. It fosters connectivity and easy data access, creating an engaging learning environment for students, faculty and researchers.

E-governance applications have also benefited from cloud computing. It enhances efficiency and cost-effectiveness by expanding, customizing, and streamlining services. This transition reduces expenses related to application management, installation, and upgrades, redirecting funds toward public service improvement.

In the medical field, cloud computing provides convenient and secure data storage and access via the internet. It enables efficient information sharing among medical professionals and patients, supporting offsite medical activities like labs, home visits, and ambulances, enhancing patient care.

Finally, cloud computing caters to a diverse audience seeking entertainment online, offering various applications like music, video, games, video conferencing, and streaming on various devices, introducing On-Demand Entertainment (ODE).

#### CHALLENGES OF CLOUD COMPUTING

- Service Availability
- Data Lock-In during platform transitions
- Data Segregation for each user
- Scaling Resources for sudden demand
- Data Location based on geographic rules

- Data Deletion as per user requests
- Recovery and Backup speed and frequency.

#### CHECK YOUR PROGRESS

##### **Q. 1. Discuss traditional computing approaches.**

**Ans.** In the not-so-distant past, computing power was considered a costly and scarce resource. However, the modern era has ushered in an age of abundant and affordable computing, largely due to the advent of cloud computing. This transformative shift represents a transition from what can be termed “scarcity computing” to “abundance computing.” This computing revolution has far-reaching implications, disrupting traditional Information and Communications Technology (ICT) industries and accelerating the commoditization of products, services and business models.

**Analogous to Utilities:** The concept of cloud computing is akin to the way we access and utilize essential utilities such as water, electricity, gas, and telephony. It provides on-demand access to computing resources, storage, software, and various IT services, all based on a usage-based metered payment model. In essence, cloud computing supplies these services much like a utility company provides essential resources. This shift toward utility-like services has profound implications for various industries and sectors.

**Transformation and Reinvention:** Cloud computing is a catalyst for the transformation and reinvention of technological partnerships, business operations, marketing strategies, and security practices. It not only reduces costs but also enhances stakeholder interest and improves the consumer experience. One of the most remarkable aspects of cloud computing is its ability to address the over-provisioning of resources, a common challenge in traditional computing environments. With cloud computing, you can align your resources precisely with your actual business needs, scaling up or down instantaneously as requirements evolve. This adaptability is a defining characteristic of cloud computing, and it underpins the technology’s widespread adoption.

**Distributed Computing Paradigm:** Cloud computing’s rise has also given birth to various forms of distributed computing, notably grid computing and cloud computing. These approaches have been instrumental in addressing the needs of applications demanding high-performance computing systems. Examples of such applications span a wide range of fields:

**Scientific and Engineering Applications:** Cloud computing is integral to the modeling, simulation, and analysis of complex systems, including climate modeling, galaxy simulations, molecular structure research, and nuclear explosion analysis.

**Business and Internet Applications:** From e-commerce platforms to web servers, file servers, and databases, cloud computing plays a pivotal role in supporting diverse online applications.

**The Challenge of Parallel Computing:** To effectively run these resource-intensive applications, the traditional approach involved parallel computing. However, this approach came with its own set of challenges. Dedicated parallel computers were not only expensive but also lacked scalability, making it difficult to meet evolving computing demands. To address this, computer scientists and engineers responded to users' demands by developing cost-effective alternatives. Cluster computing, grid computing, and cloud computing emerged as solutions that could adapt to the shifting landscape of computing requirements.

**Cloud Computing and the Future:** Cloud computing represents a pivotal shift in the world of technology, paving the way for more accessible, cost-effective, and scalable computing resources. Its impact extends across a broad spectrum of industries and applications, from scientific research and engineering to business operations and e-commerce. As we continue to harness the power of the cloud, we can anticipate further innovations and transformative changes, all underpinned by the principles of abundance computing and the flexibility it offers to meet the ever-evolving needs of businesses and users alike.

**Q. 2. Discuss the evolution of computing: From clusters to clouds.**

**Ans.** In the realm of computing, the landscape has undergone a remarkable transformation over the years. Today's personal computers boast unprecedented levels of computing power, and networking capabilities have made monumental strides. The ability to connect clusters of workstations with latencies and bandwidths comparable to tightly coupled machines has become a reality. This evolution can be traced back to various phases, including cluster computing, grid computing, and, ultimately, cloud computing.

**Cluster Computing: A 90s Revolution:** The concept of clusters began to gain prominence in the 1990s, setting the stage for the future of computing. Clusters represent a network of interconnected

computers that operate collaboratively, sharing the processing load. The enhanced connectivity and cooperation among these machines led to significant advancements in computing capabilities.

**Grid Computing Emerges:** The term "grid computing" emerged in the early 1990s as a metaphor to describe the vision of making computing power as accessible as the electric power grid. Grids were envisioned as an innovative extension of distributed computing technology. They aimed to provide users with the ability to tap into a vast network of interconnected computers to harness computational power when needed.

**The Journey to Cloud Computing:** The evolution of computing continued with the development of cloud computing. This journey encompassed various phases, each contributing to the eventual emergence of the cloud:

**Grid Computing:** Grid computing laid the groundwork for the concept of shared computational resources and accessibility. It was a stepping stone towards the broader cloud computing paradigm.

**Utility Computing:** Utility computing introduced the idea of paying for computing resources on-demand, akin to how one pays for utilities like electricity. This marked a significant shift in the cost model for computing.

**Application Service Provision (ASP):** The ASP model involved delivering software applications via the internet. It paved the way for the Software-as-a-Service (SaaS) model that is now integral to cloud computing.

**Software as a Service (SaaS):** SaaS evolved as a means to provide software applications to users over the internet. It was a pivotal phase in the development of cloud computing.

**The Internet and Corporate Technology:** The roots of cloud computing are intricately entwined with the development of the internet and corporate technology. Cloud computing emerged as a solution to the challenge of how the internet could enhance corporate technology infrastructure. This innovative approach addressed the need for scalable and efficient computing resources to support evolving business requirements.

**A Brief History of Cloud Computing:** While the concept of cloud computing may seem relatively new, its history is intertwined with the development of the internet and its applications. In 1999, the first cloud computing websites catering to both businesses